THE IMPLICATIONS OF CUSTOMER PRIORITIZATION ON LEAD TIME

A Thesis

Presented in Partial Fulfillment of the Requirements for

the Degree Bachelor of Science in Business Administration in the

Fisher College of Business at The Ohio State University

By

Amy Christine Starr

* * * * *

The Ohio State University
2005

Thesis Examination Committee:

Dr. Keely Croxton, Advisor

Dr. Tom Goldsby

Dr. Rao Unnava

Approved by

_____
Advisor
Department of Marketing & Logistics

ABSTRACT

With the recent heightened interest in supply chain management, more companies are focusing on customer segmentation in non-traditional ways. One way to use customer segmentation is to provide more benefits to the top tier customers than provided to the lower tier customers, because top tier customers provide more benefit to the company. A company can provide more benefits to top tier customers in a variety of ways, such as faster service, more consistent service, or customized service procedures.

For the purposes of this project, I chose to focus on the implications of providing faster service to top tier customers. Therefore, I developed a simulation model using Arena simulation software to model an order fulfillment process in which top tier customers always receive priority over middle and bottom tier customers, and likewise middle tier customers over bottom tier customers. Through scenario analysis I study the effects of different system variables on the time in system for each tier, namely different proportions of customers or orders in each tier, different process variability, and different utilization levels of the system.

The results show that between the ranges of orders for top tier: 1-20%, middle tier: 20-40%, and bottom tier: 55-70%, there are similar results on lead time. Top and middle tier customers always have an average and maximum lead time less than that of the benchmark case in a first-in first-out system. On the other hand, bottom tier customers always take longer than in the benchmark case. With a wider range of

proportions for each tier, the top tier reaching as high as 60%, this is true as well. However, the time in system for bottom tier customers or orders grows exponentially as the proportion of top tier customers or orders increase.

In terms of process variability, the results show that variability has a minimal effect on the average time in system for all tiers of customers. However, as the variability of the system increases, the maximum time in system for bottom tier customers is highly volatile, thereby making it difficult for managers to set customer expectations of lead time. The utilization level affects the bottom tier customers the most, whereby the relationship between utilization level and maximum time in system for bottom tier customers is exponential.

Through this research I have contributed to the area of supply chain management by beginning to show the effects of customer segmentation. Managers can use this data to aid in priority management and set reasonable customer expectations of lead time. Future research using additional scenario analysis and simulation improvements applicable to this study will further advance the understanding of customer segmentation.

Dedicated to my supportive family and fiancé

ACKNOWLEDGEMENTS

I would like to thank my advisor, Keely Croxton, for her support and effort, which made this thesis possible. Without her time and dedication I could not have completed this project. Keely has been an awesome advisor, helping far beyond her expected duties as a professor. She has been there for inspiration and ideas, yet has also always challenged me to think on my own and take ownership of my research. I am so thankful for her contributions to my research project.

I would like to thank Professor Michael Knemeyer for his insights into my project and for his idea to develop a simulation model. I would like to thank Professor Rao Unnava for his office hospitality and letting me use his computer for my project. I would also like to thank Professor Unnava and Professor Thomas Goldsby for their feedback on my project.

I would like to thank my coworkers in the Undergraduate Programs Office for their support and visible enthusiasm for my project.

Lastly, I would like to thank my family, fiancé, and friends for their support of my project and everything I do. They have been incredibly motivational throughout my academic career as I have pursued my goals. My parents and fiancé have helped me in every way possible, without which I would have not been able to complete this project. I would also like to thank my grandmother and aunt for their help in editing this paper.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

A common practice in today's business environment is to segment customers based on various characteristics in order to provide a higher service level to top customers. This practice is logical, because those customers who benefit the company in a significant way should receive treatment that reflects this benefit, in order for the company to continue receiving the customer's business. Benefits to the company can range from profitability to market knowledge (such as knowledge about the preferences of a targeted consumer group) and are highly company specific depending on their goals and strategies.

One way to provide a higher service level to top customers is through a shorter or more consistent lead time. In order to achieve shorter or more consistent lead time, companies can assign priorities to customer orders. This assignment of priorities has an effect on lead times for the various classes of priorities. The degree to which the priorities have an effect on lead times depends on several factors, including the proportion of customer orders in each class of priorities, the variability of the system, and the utilization level of the system. Whether companies have a formal process for assigning priorities to customers or they assign priorities on an ad hoc basis, most

companies are unaware or have no way to quantify the implications of this prioritization on the lower priority customers. Ideally, a company would want to manage their priorities in such a way as to maximize the overall profitability of the company. In order to maximize the overall profitability, it is essential for a company to be able to measure the trade-off inherent in offering higher service levels to some customers. Thus, it is important for managers to understand how prioritization effects service levels for all customers. This paper studies the implications on order fulfillment times of assigning priorities to segmented customers.

The goal of the study is to answer the question: How does customer prioritization effect the lead times of all classifications of customers? This question examines how quickly customers in various segments are serviced, which relates to the priority rules that are defined in the order fulfillment process. These priority rules directly stem from the expectations that are established in customer relationship management.

In examining the question I begin by discussing the research methodology chosen to evaluate the effects of prioritization. I then describe the specific simulation model that I developed, as well as the assumptions that were integrated into the model. Following the model description I discuss the performance measure I used to analyze the simulation scenarios. Several simulation scenarios are then examined in detail, followed by a summary of this analysis, as well as a discussion of potential future studies related to segmentation.

CHAPTER 2

THE BUSINESS ENVIRONMENT

2.1 Customer Segmentation

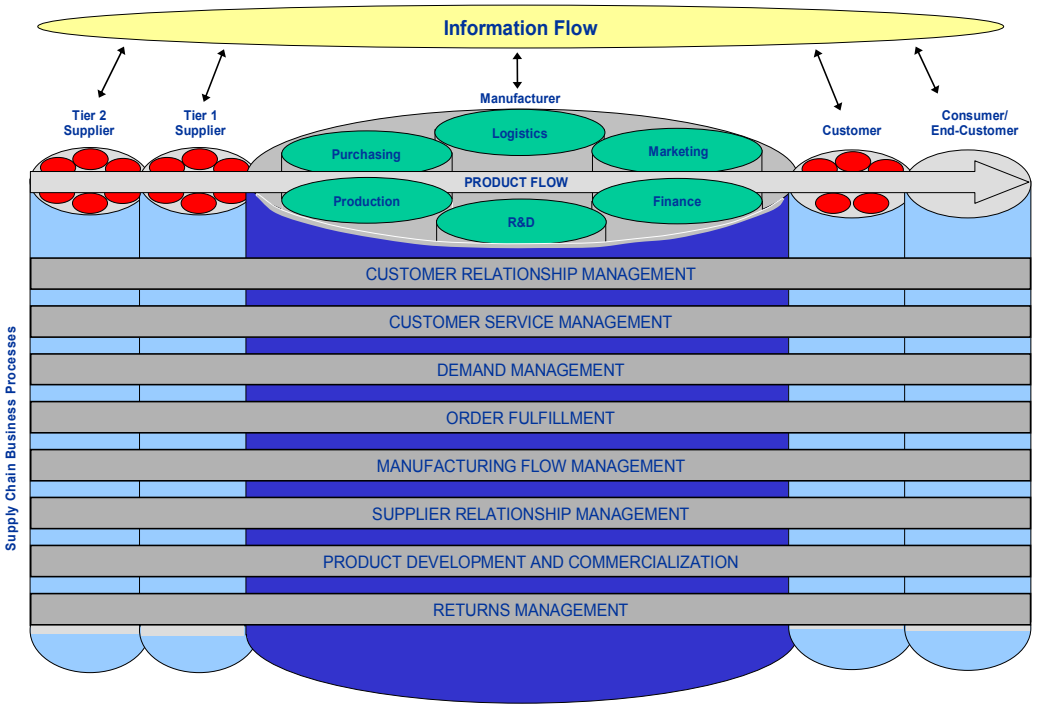
Customer segmentation has been widely used by companies for traditional marketing purposes, but has also recently been utilized by companies in nontraditional fashions. According to Badgett *et al.* (2005), the goal of customer segmentation is to use the knowledge gained from knowing your customers better to enhance the overall profitability of the company. In a recent study, Zeithaml *et al.* (2001) show that higher-tiered customers increase profitability by a higher margin with an increase in customer service levels than lower-tiered customers. Therefore, companies have started to use formal customer segmentation to determine the appropriate level and quality of service they need to deliver to specific customer segments (Badgett *et al.*, 2005). By formalizing the approach to categorizing customers, whether through a tiered pyramid or one of the many other approaches, companies can better identify and interact with the different segments in a way that works towards the goal of company profitability. Companies have been informally utilizing this technique of providing better service to top customers, but without a formal approach companies cannot be sure that the differentiation enacted is in the best interest of the company.

One way to get to know your customers better, and therefore enhance the overall profitability of the company, is through customer relationship management. Customer segmentation is one aspect of customer relationship management. However, only about 17% of companies who have a customer relationship management system use the analytic applications that enable them to effectively segment customers (Badgett *et al.*, 2005). Customer relationship management is one of the key business processes presented in The Global Supply Chain Forum's supply chain management framework.

2.2 Supply Chain Management

With the recent increased interest in supply chain management, several attempts have been made to explain and define the concept; these attempts have varied in nature from academic and professional articles to frameworks. For the purpose of this study, I use the framework developed by The Global Supply Chain Forum, which defines supply chain management as *"the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders"* (Lambert, 2004). Although successful implementation of this framework is accomplished through the supply chain network structure, the business processes, and the management components, the framework concentrates on the details of eight key business processes critical to supply chain management. The eight processes, as illustrated in Figure 2.1 are customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialization, and returns management. Within each business

process are strategic and operational sub-processes, which describe the strategy, goals, and activities for each process. Furthermore, each of the eight business processes interface with the other seven processes in specific and defined ways. Two of these key processes, customer relationship management and order fulfillment, are relevant to this research so I will describe them in more detail.



Source: Adapted from Douglas M. Lambert, Martha C. Cooper and Janus D. Pagh, "Supply Chain Management: Implementation Issues and Research Opportunities," *The International Journal of Logistics Management*, Vol. 9, No. 2 (1998), p. 2.

Figure 2.1: Supply Chain Management: Integrating and Managing Business Processes Across the Supply Chain

2.3 Customer Relationship Management

The first of the eight key business processes is customer relationship management, which is the critical supply chain management process for considering customer segmentation. Customer relationship management focuses on developing and maintaining relationships with customers in a way that generates a mutually beneficial relationship (Lambert, 2004). Not all customers provide the same benefit to the company, so a company must decide how to differentiate its customers.

As can be seen in Figure 2.2, two strategic sub-processes of customer relationship management focus on identifying criteria for categorizing customers and establishing guidelines to determine to what degree this differentiation should occur in the product and service agreement (PSA). It is important to note that not all companies use the term PSA; however, whether formal or informal and regardless of the name, most companies use PSAs when conducting business with customers.

The first strategic sub-process in customer relationship management that deals with customer segmentation defines criteria that is important for categorizing customers. This criteria is going to be different from company to company based on the needs and goals of the company, both in the short-term and long-term. Some of the criteria that companies can use to segment customers are: profitability, growth, volume, competitive positioning, market knowledge, market share goals/penetration, margin, technology, resources, compatibility, trade channel, and buying behavior (Lambert, 2004).

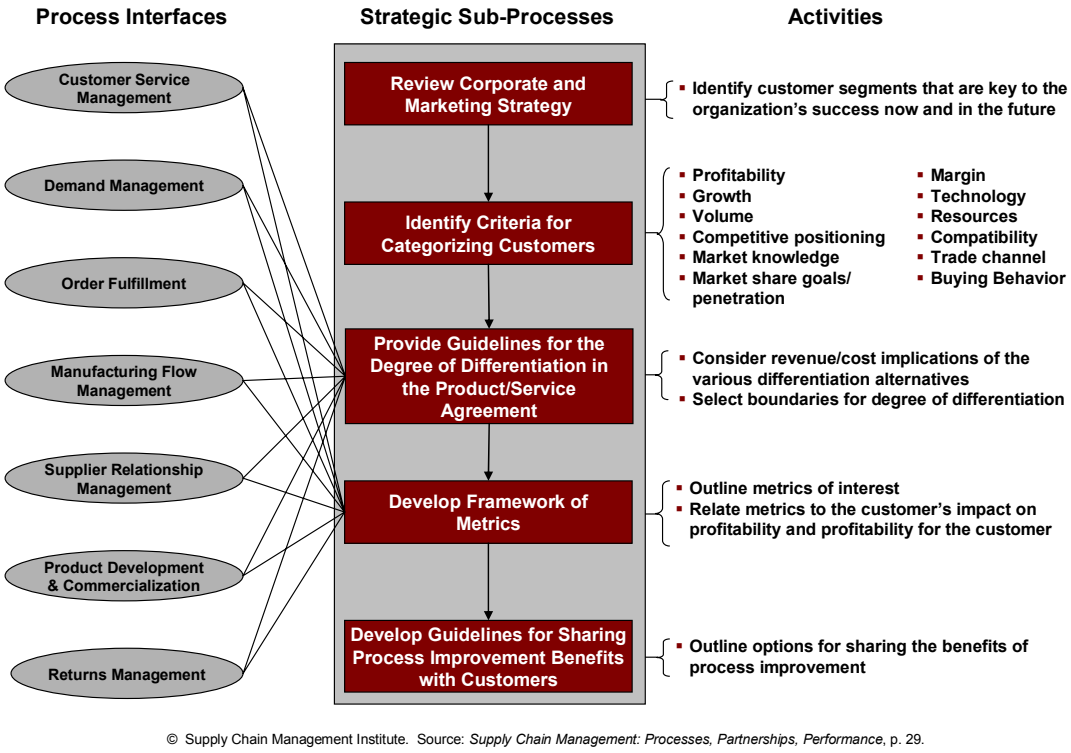


Figure 2.2: The Strategic Customer Relationship Management Process

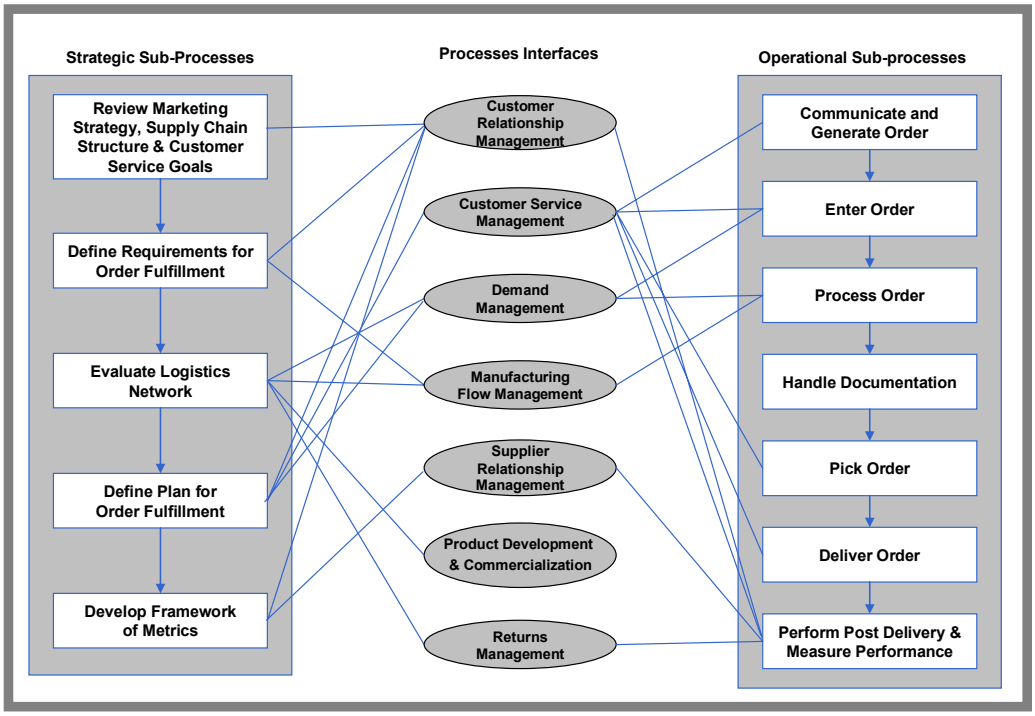
Once the customers are segmented based on the defined criteria, the company needs to determine how the segmented customers should be differentiated. This means that companies need to include parameters in the PSA, such as order minimums, will calls and appointments, purchase order confirmations, pricing inquires, backorders, and contract items, to name a few. Furthermore, the higher segments will have tailored PSAs, which require more time and customization, whereas the lower segments will be given standard PSAs. The customer relationship management process determines when a tailored PSA should be developed for a customer, and when a standard PSA is

acceptable. Additionally, customer relationship management addresses which parameters in a PSA are customizable and to what degree the service level can be improved for the higher customer segments. One area where companies can differentiate between customers is in the lead times they offer, which is what I study in this research.

2.4 Order Fulfillment

The other key process of The Global Supply Chain Forum framework that relates to customer segmentation is order fulfillment. The order fulfillment process focuses on the activities a company uses to define and meet customer expectations while working to minimize the overall cost to the company. In this process the segmentation established in customer relationship management can be used. Once customers are formally segmented and the parameters in the PSA are determined through customer relationship management, order fulfillment requirements are developed to meet these parameters.

An activity of the order fulfillment strategic sub-process *Define Requirements for Order Fulfillment* is to define lead-time and customer service requirements for each customer segment, as determined by customer relationship management (Figure 2.3). Once defined, order fulfillment must set-up or modify the order fulfillment process to accommodate and meet the requirements. In the case of lead time, order fulfillment needs to determine rules that will allow orders from different segments of customers to be delivered within the set lead time.



Source: Adapted from Keely L. Croxton, Sebastian Garcia-Dastugue, Douglas M. Lambert , and Dale S. Rogers, "The Supply Chain Management Processes," The International Journal of Logistics Management, Vol. 12, No. 2 (2001), p. 19.

Figure 2.3: The Order Fulfillment Process

Therefore, it is in the order fulfillment process that the priority rules are established in order to meet the customer expectations that are set in the PSA. Depending on the proportion of customers in each segment, companies may choose different priority rules in order to meet customer expectations. For example, if a company has 10% of its orders coming from the top tier, 30% from the middle tier, and 60% from the bottom tier, the company might choose to always give priority to the top tier customers throughout the order fulfillment process. However, some companies are in the situation where closer to 60% of their orders come from top tier customers. In this case the company might

choose different priority rules, in which a bottom tier customer can only be delayed so long before they receive priority over a top tier customer; otherwise the time in system for the bottom tier would be significantly longer than a top tier customer. The critical factor is customer expectations, which are determined in the PSA through customer relationship management. Order fulfillment must be aware of these expectations and manage the process accordingly.

2.5 In Practice

Several companies in various industries employ these new customer segmentation strategies. One of the top five financial services companies uses data mining and activity based costing to segment customers into tiers. Once into defined tiers, the company treats the separate segments differently through customer service representatives, who give better service to the top tier; sales representatives, who can offer a greater basis point reduction to the top tier; and through the level and quality of phone service, which is improved for the top tier (Badgett *et al.*, 2005).

Aside from financial services, other industries are using customer segmentation in nontraditional ways as well. According to Badgett *et al.* (2005), one of the top-tier office supply companies uses segmentation to structure the loyalty program, in which they offer greater rewards to the top tier customers. A leading property and casualty insurance company uses customer segmentation in the product development group to develop specific products that will only be offered to top tier customers.

A real world example that many individuals can relate to that deals with customer segmentation is airline security. As all passengers (airline customers) are waiting in line

to go through security, first-class passengers jump to the front of the line. This parallels companies prioritizing customers in order fulfillment in order to reduce the lead time. In this analogy, the simulation model I develop shows the implications on the other passengers waiting to get through security depending on several factors, namely how many first-class passengers there are, how close to capacity the security is operating, and the variability of how long it takes for each person to get through security. Although this situation is not perfectly analogous to a company's order fulfillment process, it is a good way to explain customer segmentation using prioritization.

CHAPTER 3

RESEARCH METHODOLOGY

The method of research selected to examine the effects of customer prioritization is simulation. Simulation was selected as the methodology for the analysis for the primary reason that it is appropriate to examine system dynamics. Modeling with simulation allows the modeler to incorporate variance across a time horizon and change the dynamics to run various realistic scenarios (Bowersox *et al.*, 1989). In this research, scenario analysis is critical to generate useful, applicable results, considering companies often have different means of categorizing customers, have different variability within the system, and operate at different capacity levels. A secondary benefit of using simulation is the visual interpretation granted to the viewer, which makes the concept easier to understand and the results more digestible (Kelton *et al.*, 2003).

Simulation is often used for analyzing problems in logistics and in the supply chain. With regards to logistics planning, simulation models are sometimes used for both structural analysis, such as facility location and distribution channel design, and operational analysis, such as inventory and production situations (Bowersox *et al.*, 1989).

Simulation provides a tool that is capable of handling the complexity present in many logistics problems.

Many supply chain studies use simulation models, because simulation is capable of representing the interdependencies between organizations. (Venkateswaran *et al.*, 2004). Two recent supply chain simulations model the operational design of a supply chain (Shang *et al.*, 2004) and inventory inaccuracy in a retail supply chain (Fleisch *et al.*, 2004).

CHAPTER 4

THE SIMULATION MODEL

4.1 Description of the Model

The simulation model was developed using Arena (Rockwell Software, 2003), which has been widely used in academia as well as in industry. As can be seen in Figure 4.1 the simulation is composed of various flowchart and data modules that model a typical order fulfillment process. The assumptions made at each stage of the process will be discussed in detail following the description of the simulation model.

There are three entity entry points into the system that model orders being created, one for each A, B, and C priority customers' orders. These entry points are separated so that classification percentages can be easily modified for various scenarios. After orders enter the system, they flow through the order fulfillment process, beginning with order processing. Once through order processing, the orders continue into an inbox where they are held before being serviced at the credit check. Following the credit check, orders continue into planning, where they are delayed until they are scheduled to proceed to order picking. After an order has been picked it continues into order staging where it is delayed until shipment is scheduled.

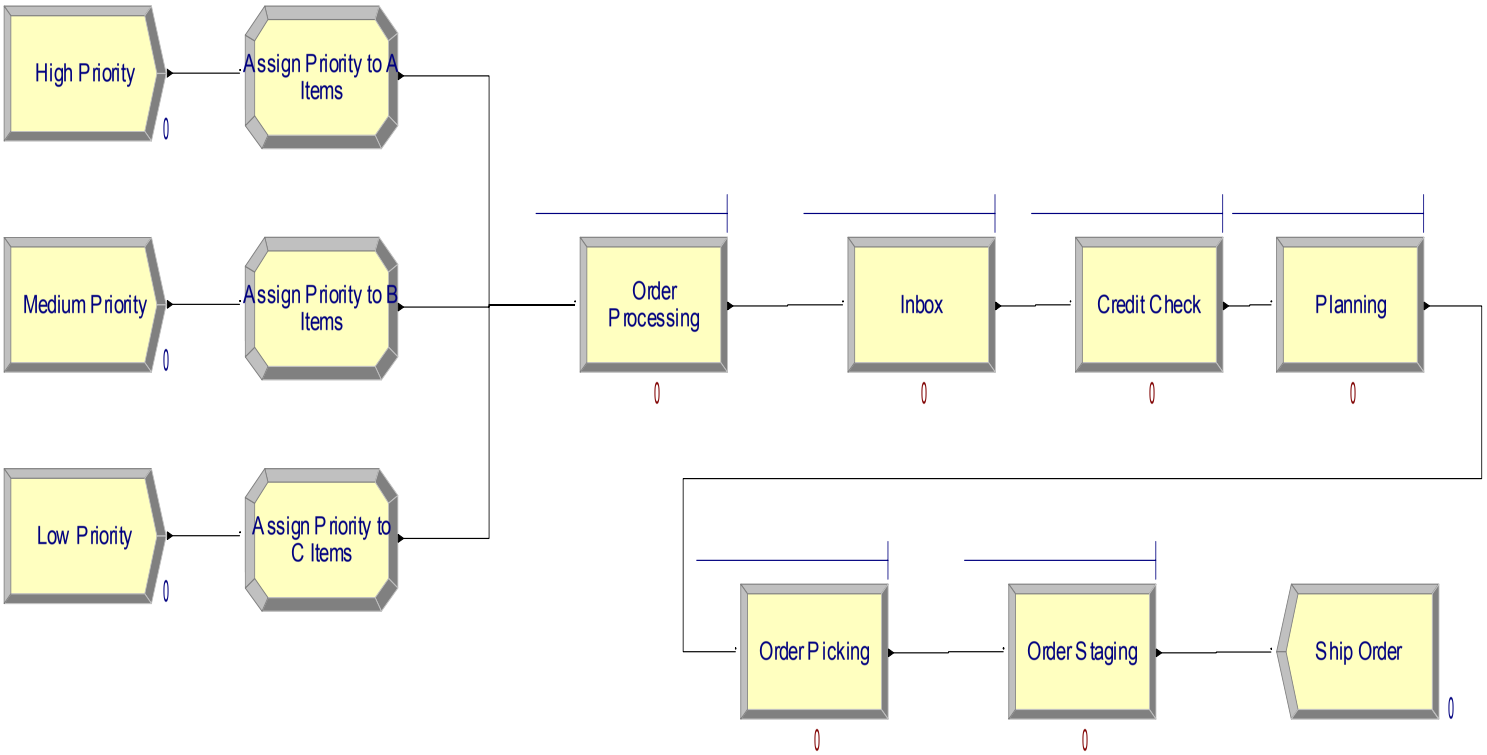


Figure 4.1: The Simulation Model in Arena

4.2 Assumptions of the Model

Several assumptions had to be made in designing the simulation model. The first assumption is that three categories of segmented customers exist: a top tier (A priority customers), a middle tier (B priority customers), and a bottom tier (C priority customers). The proportion of customers in each segment is a variable that I study the effects of in my analysis. In the model the proportions of segmentation represent the volume of orders in the segment, meaning that a high proportion of A priority orders could represent either a large number of top tier customers or frequent purchases from top tier customers.

The second assumption deals with the decision rules implemented to determine how priorities are handled. At every stage throughout the process priorities take precedence, which means that A priority customers jump ahead of B and C priority customers, and B priority customers jump ahead of C priority customers. This assumption was made given that the purpose of analyzing the effects of customer prioritization is to understand what happens when customers are segmented and treated accordingly. However, it is undeniable that companies use various decision rules when processing orders, and thus may not always give preference to A customers over B customers over C customers. Nonetheless, in order to best examine the effects of prioritization, I assume that customers of a higher classification always receive priority throughout the process.

I assumed that the interarrival times between orders followed an exponential distribution, because that is what is commonly accepted for interevent times in random arrival processes (Kelton *et al.* 2003). Therefore, regardless of the percentage of customers in each classification, all interarrival times follow an exponential distribution.

The interarrival times for each segment of customers are based on the assumed order processing time and utilization level of the system for each scenario. Given the processing time assumptions that follow and a targeted utilization level, the number of top tier customers or orders will be weighted according to the proportion of customers in the top tier. This makes the interarrival time the inverse of the number of orders. For example, in my model I assumed that at 94% utilization 30 orders could get through order fulfillment in a given day. Therefore, if top tier orders make up 15% of the total orders, the interarrival time would be .2222 days (1/(15%*30)) for a 94% utilization level.

In my simulation, the order fulfillment process has six stages. At each stage the processing time follows a normal distribution. Table 4.1 shows the details of processing times for each stage.

	Average Time (in days)	Cumulative Time (in days)	Distribution
Order Processing	.063	.063	N(.063,.0945)
Inbox	1/2	0.563	N(.5,.075)
Credit Check	.063	0.626	N(.063,.0945)
Planning	1	1.626	N(1,.15)
Order Picking	.95	2.576	N(.95,.1425)
Order Staging	1	3.626	N(1,.15)

Table 4.1: Order Processing Stages

Order processing takes, on average, only about $1/16^{th}$ of a day, after which the orders sit in the inbox for half of a day. With the advancement of technology, order processing requires very little time, since most of the work is done electronically. The

time period of half a day for the Inbox was created to simulate a realistic situation where office administration workers have more tasks to perform than just credit checks. Therefore, a typical order would have to wait in the inbox before moving to the next stage. Once out of the inbox, the orders proceed to credit check, which similar to the order processing takes, on average, about $1/16^{th}$ of a day. The time frame for the credit check is proportionally equal to order processing for the same reason that technological advances have sped up this process drastically in recent years. After the credit check, orders move into the planning stage for a day, which seems to be a typical planning time frame for order fulfillment systems. The planning horizon has historically been longer than one day, but with computer software that is able to automate most of the planning decisions, the planning time frame has been reduced. After the day in planning, the order is delayed in order picking for, on average, one day. Obviously most orders do not take a full day to pick; however, many order fulfillment operations pick in batches or waves, which means that orders will not be staged until the entire batch or wave is finished. Again, the time frame on the order picking will vary by company, but one day seems adequate for this simulation. The final process is order staging, whereby the order is prepared to be shipped. This process takes on average one day, and then the orders proceed to be shipped to the customer.

With regards to the distribution selection, I chose the normal distribution in order to be able to vary the variability of the processes. However, the normal distribution does have a flaw for processing times, which is that since it is symmetrically distributed around the mean and is an unbounded distribution, there is a chance that a negative value could be returned (Kelton *et al.*, 2003). However, in most of the simulations the mean is

at least three or four standard deviations from zero, except in the scenario analysis of high variability, in which case there is a higher chance of a negative value being returned. In the case of a negative value return, Arena automatically returns a value of zero, which means that negative numbers are not an issue in the simulation. Furthermore, given that most of the analyses are not close to zero with several standard deviations from the mean, and given that the data for the high variability runs appears unaffected, the normal distribution seems to work appropriately in this model despite the flaw in the distribution.

At each stage throughout the system, not only is it necessary to establish an average timeline, but also specify the variability of each stage. I chose to use 15% variability as the benchmark for process-time variability for each stage, however I also changed the variability in an experimental setting to measure the effect that variability has on the implications of customer prioritization.

Another assumption I made regarding the processes within the order fulfillment process is the number of resources available in each process for the entity (order) to seize. In other words, once an order arrives at a process, will it have to wait for a resource to become available? In the case of order processing, I established that there would be two order processors available to process orders. Therefore if an order arrives and the two order processors are busy, the orders will have to wait in a queue to be processed. It is in this queue that when A priority customers arrive they jump ahead of B and C priority customers, and likewise with Bs to C priority customers. Limited resources are designated to only three stages in the system: order processing, credit check, and order picking.

The remaining three processes of the inbox, planning, and order staging have unlimited resources to service the orders. This is because orders typically do not form a queue at any of those processes. An inbox has unlimited space for orders to pile up, orders arriving at planning are planned as they arrive, and order staging generally occurs when the orders reach the staging area.

The final assumption I made in the simulation model was the duration of the simulation necessary to achieve unbiased results. Similar to a procedure used by Brown *et al.* (2001) and Fleisch *et al.* (2005), I ran each simulation for 200 time periods, which is equivalent to 200 days. The first 10 days constitute a warm-up period, and the simulation results begin tracking on the eleventh day in order to avoid any bias from starting conditions. As proposed by Swaminathan *et al.* (1998) and also performed by Fleisch *et al.* (2005) these 200 days are run 20 times for each scenario in order to achieve statistically improved results. Numbers presented then represent the average results over the 20 runs.

4.3 The Benchmark Case

In order to have a basis for comparison for all of the scenario analysis, I first developed a benchmark case that shows the system in a state without priorities. This means that as orders come into order fulfillment they do not receive a priority tagm and therefore proceed through the system on a first-in first-out basis. In the benchmark case for varying the proportion of top-, middle-, and bottom tier customer orders, the total number of orders entering the system is 30, generating a utilization level of 94%, which

is held constant throughout the proportion analyses. The variability of the processes is 15%, which is also held constant throughout the proportion analyses.

For the analyses pertaining to process variability and utilization level, I had to determine a benchmark level for each variability and utilization level with a first-in first-out system. For each benchmark case an average and maximum time in system is generated for top-, middle-, and bottom tier customers, which are slightly different due to variability of the system. I therefore came up with the benchmark number by averaging these averages and maxima. The benchmark case results are depicted in each of the following graphs with a horizontal line.

4.4 The Performance Measure

Throughout the various simulation scenarios the primary metric I used to measure the effects of customer prioritization is time in system. The time in system corresponds to a lead time that can be offered to the customer of the given category. Both the average time in system and the maximum time in system are important values to consider in the analysis. Depending on the company and the tailored product and service agreements with customers, a company could look at the average or maximum time in system to establish a lead time. If the company uses the average time in system to set lead times, on average the company will be able to meet the designated lead time. However, average is not acceptable to many customers, particularly those who use just-in-time systems and more highly value consistency over speed. In this case, the maximum would be a more appropriate measure to use and incorporate in the product and service agreement with the particular customer. Referring back to customer relationship management, the key is to

acknowledge what is important to mutually benefit the company and the customer, and then incorporating the appropriate terms in the product and service agreement.

CHAPTER 5

ANALYSIS OF SIMULATION RESULTS

In this chapter I examine the results of the various simulation scenarios. I begin by looking at different proportions of customers in each tier, and how an increase in a proportion of one tier to another impacts the time in system. I then examine the implications on lead time when there are different levels of variability in the processes in order fulfillment. Finally, I run a simulation analysis to show the impact that utilization level of order fulfillment has on the time in system for the segmented customers.

5.1 Varying Proportions of A, B, and C Priority Customer Orders

For many companies it is a challenge to determine how many customers should be in each segment. Therefore, the first analysis is an attempt to understand the effects of varying proportions of the customer-tiers on the time in system. Depending on the criteria companies use to segment customers, companies will have various ranges of proportions of orders in each customer segment or tier. If a company segments based on profitability, it is likely that the proportion range of segments will follow a pyramid distribution, where the smallest number of customers are in the top tier, and the largest number of customers in the bottom tier. Conversely, if a company segments based on

purchase volume, the proportion of customers in each segment may follow a pyramid distribution, however, the proportion of orders will not; in this case, the proportion of orders will be higher at the top. Therefore, in the simulation I examine both cases, where the range of orders for segmented customers follows a pyramid distribution, and where there is a wider range of orders from top tier customers.

5.1.1 The "Normal" Range of Proportions

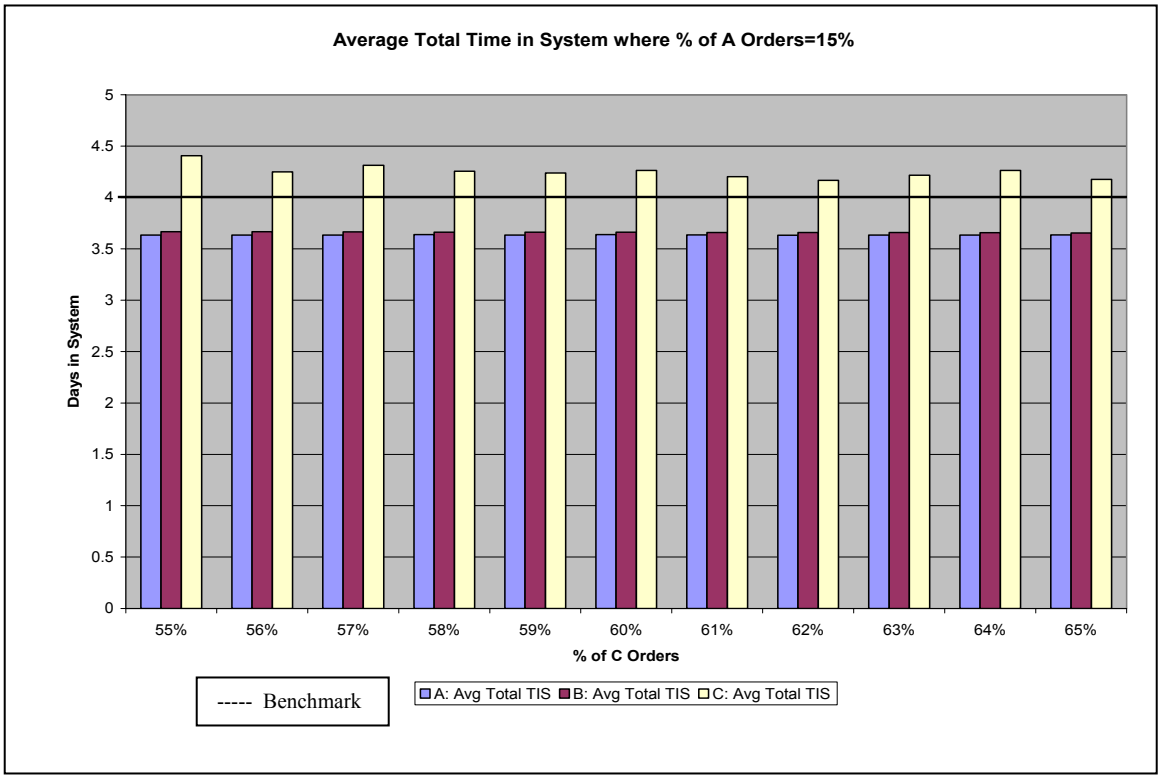
The "normal" ranges of proportions that follow a pyramid distribution are: for A priority orders 1-20%, B priority orders 20-40%, and C priority orders 55-70%. In order to fully examine the system dynamics, I ran multiple scenario analyses where I held the percentage of either A, B, or C priority orders constant, and varied the proportion of the other two segments accordingly.

5.1.1.1 Holding A Priority Orders Constant

In order to examine a specific case in detail, I chose A priority orders to be held constant at 15%, which can be considered a "normal" percentage of top tier customers. I could have selected any proportion within the range of 1-20%, but since it is common for companies to have between 10-20% top tier customers, I chose 15% as the constant percentage of top tier customer orders. With the percentage of A priority orders held constant at 15%, the percentages of B and C priority orders vary between and 20-30% and 55-65% respectively. The expectation of this analysis is that as the percentage of B priority orders increases, the longer C priority orders will take to complete the order fulfillment process.

However, as seen in Figure 5.1, the average and maximum time in system for C priority orders seems to have a weak relationship to the increasing percentage of B priority orders. The average and maximum time in system for C priority orders lengthens as the percentage of B priority orders increases, but not constantly due to variability. Over time, as the percentage of B priority orders increases, the average and maximum time in system for C priority customers is longer. In every case, the average and maximum time in system for A and B priority orders is less than in the benchmark case, and for C priority orders is longer than in the benchmark case.

There seems to be a lot of fluctuation of the maximum time in system, which means that as the proportion of orders fluctuates between B and C priority orders, managers need to be particularly careful to set correct expectations of lead time for lower tier customers, understanding that the maximum time in system fluctuates with variability, but generally increases, as the proportion of B to C priority orders increases.



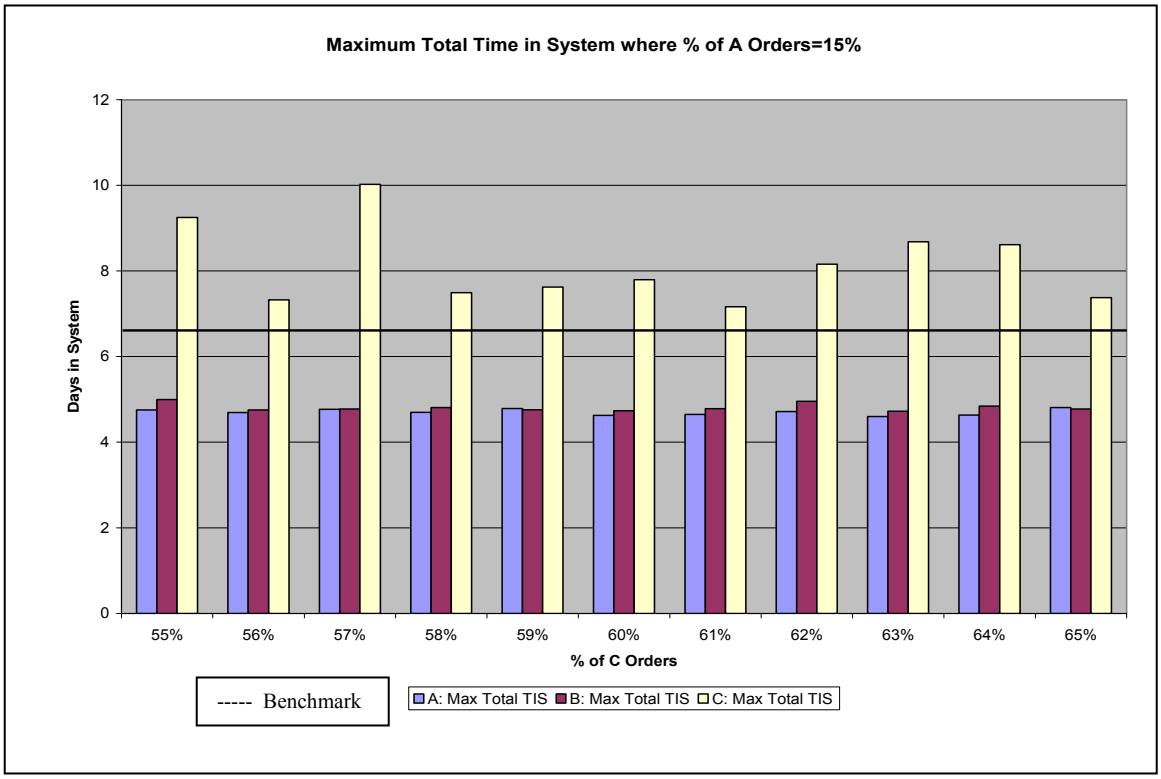


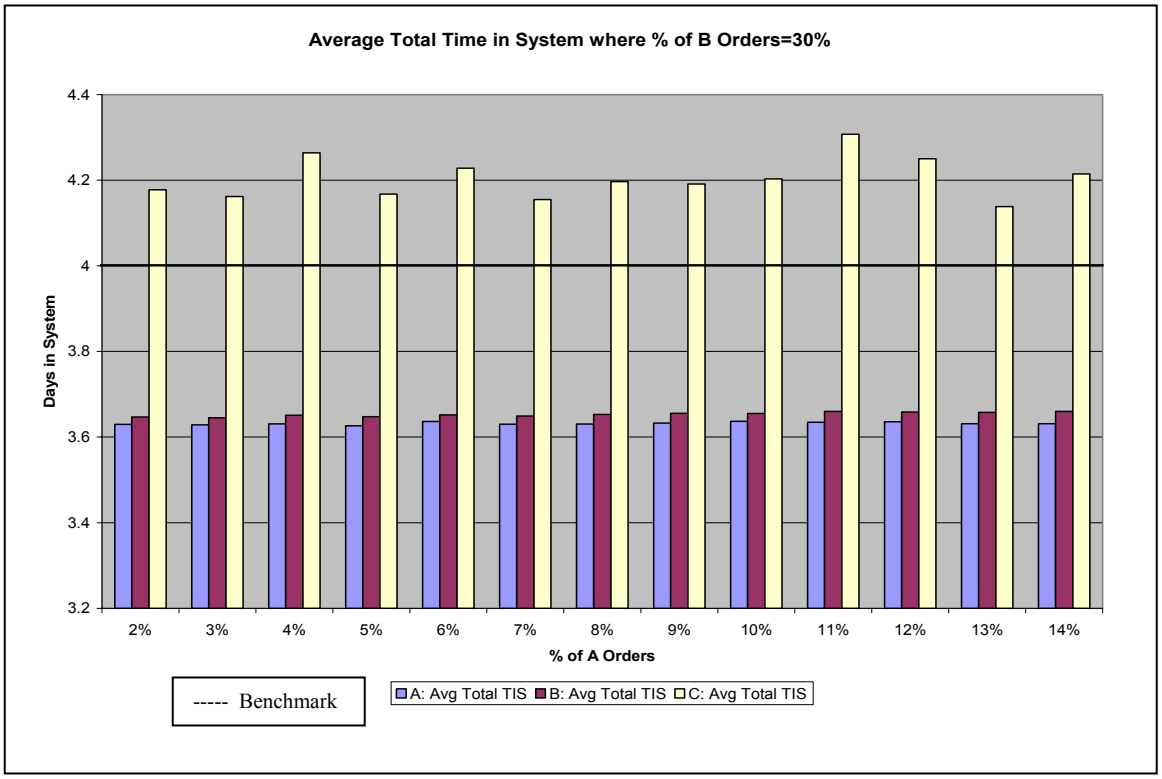
Figure 5.1: Average and Maximum Total Time in System
Holding the Percentage of A Priority Orders Constant at 15%

5.1.1.2 Holding B Priority Orders Constant

Similar to the previous case, I had to choose a specific percentage for B priority orders to hold constant. I could have selected any percentage within the range of 20-40%, so I chose the midpoint of 30%. As the percentage of B priority orders are held constant at 30%, the percentage of A and C priority customers vary between the ranges of 2-14% and 56-68% respectively. The expectation of this analysis is that as the percentage of A priority orders increases, the time in system for C priority orders will increase.

However, as the results in Figure 5.2.1 show, there is not a constant increase of the average or maximum time in system for C priority orders as the percentage of A priority orders increases. The average time in system is always close to four days, which is just above the benchmark time. The maximum time in system increases over the range, but not constantly due to variability with the marginal increases of the percentage of A priority orders. I will show the effect of a larger increase in the percentage of A priority orders on average and maximum time in system for C priority orders in a later analysis.

One further analysis is necessary for this case, because of the wave of the graph seen in the maximum time in system for C priority orders in Figure 5.2.1. Therefore, I ran the simulation for twice as long and twice as many times: 40 runs for 400 days each. These results can be seen in Figure 5.2.2, which shows that the wave in Figure 5.2.1 is not repeated over a longer period of time, implying that the wave is due to variability of the processes.



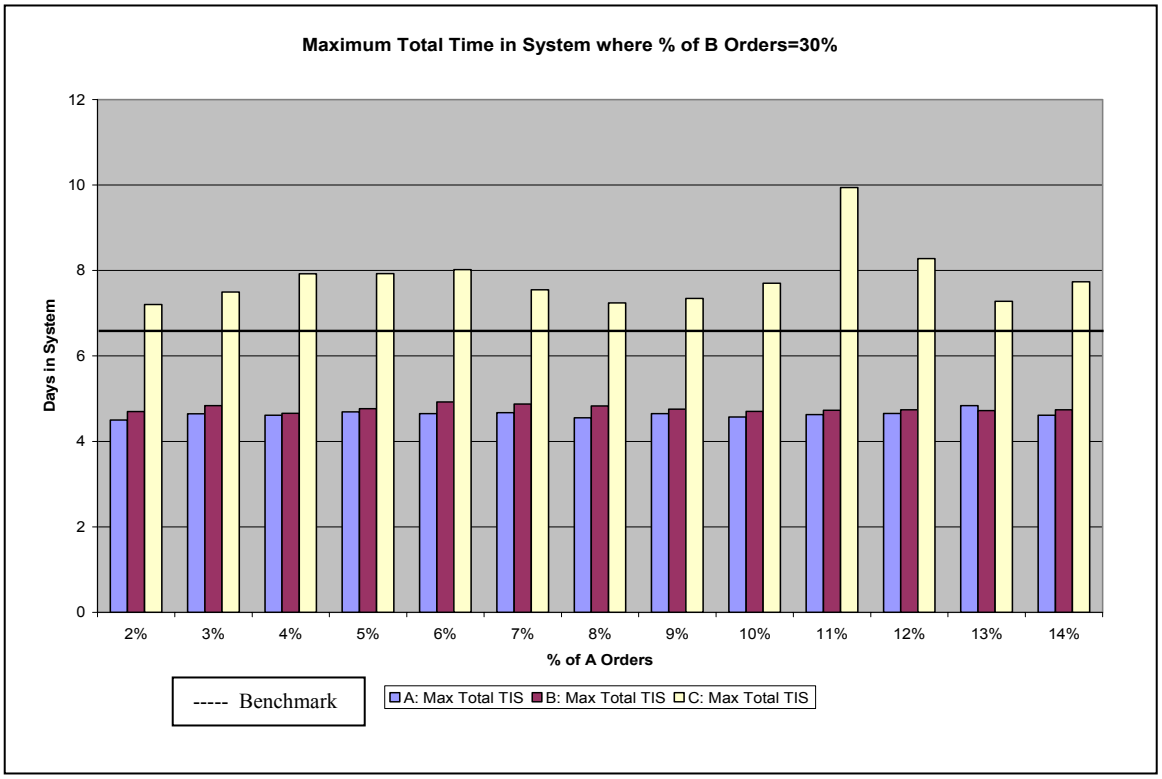


Figure 5.2.1: The Average and Maximum Total Time in System
Holding the Percentage of B Priority Orders Constant at 30%

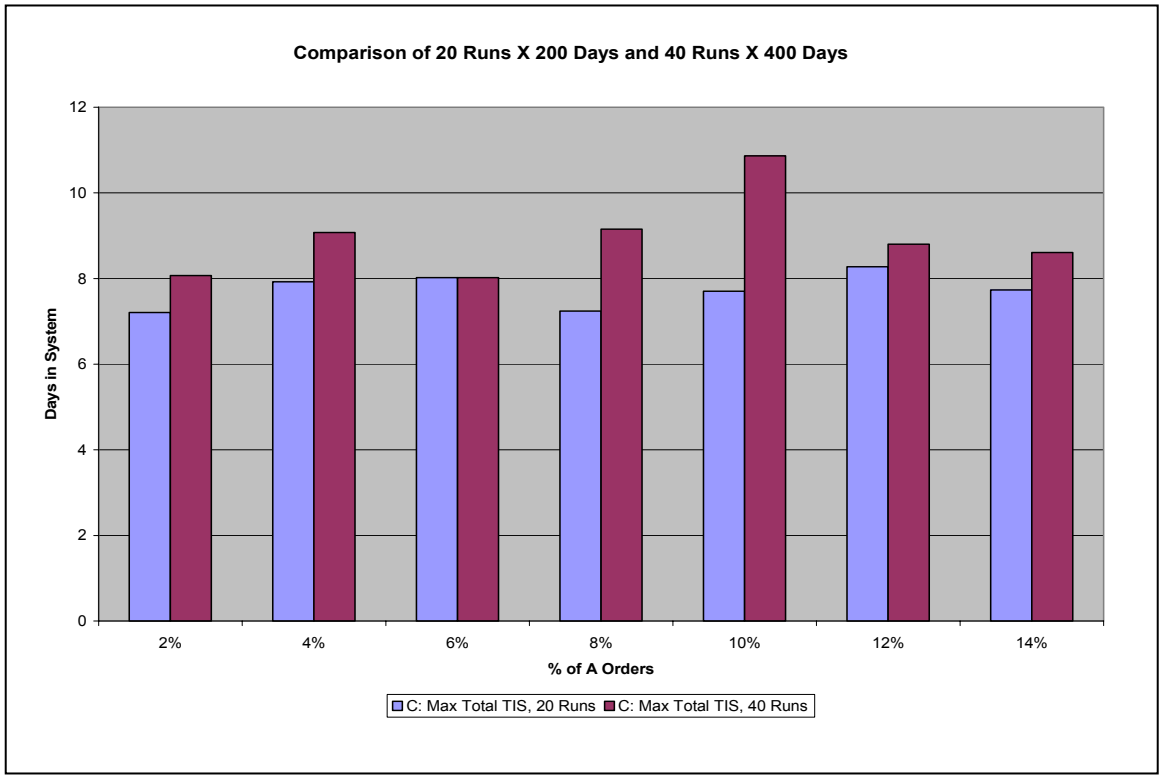


Figure 5.2.2: Maximum Time in System for C Priority Orders with 20 Runs for 200 Days and with 40 Runs for 400 Days

Therefore, as the proportion of A priority orders to C priority orders increases, the implications for lead time are that the maximum time in system for C priority orders increases over time but not constantly due to variability. For managers, this means that as the proportion of A to C priority orders increases, they need to carefully set bottom tier customer expectations of lead time to reflect the increase in the maximum time in system, while recognizing that this maximum time in system is also dependent on variability.

5.1.1.3 Holding C Priority Orders Constant

Similar to the previous two analyses, I had to choose a specific percentage of C priority orders to hold constant. I chose 60% as the "normal" percentage within the range of 55-70% for the analysis. Therefore, the scenario analysis hold the percentage of C priority orders constant at 60% and alternates the percentage of A and B priority orders between the ranges of 1-20% and 20-39% respectively. The expectation of this analysis is that as the percentage of A priority customers increases, the time in system for B priority orders will increase.

However, as can be seen in Figure 5.3, the results show that as the percentage of A priority orders increases, there is no significant impact on the average and maximum time in system for B priority customers. A and B priority orders always have a lower average and maximum time in system than in the benchmark case, and C priority orders always have a higher average and maximum time in system than in the benchmark case.

This is most logically explained by the fact that with 60% C priority orders, A and B priority customers always account for 40% of the orders. Therefore, all 40% always get through the system in less time than in the benchmark case because they jump ahead of C priority customers. On the other hand, C priority customers always get jumped ahead of, and therefore take longer to make it through the system, regardless of whether it is an A or B priority order that passes the C order.

The implication for managers is that holding the proportion of bottom tier customers constant relative to a varying proportion of top and middle tier customers will

have a minimal effect on the average and maximum time in system for all tiers of customers.

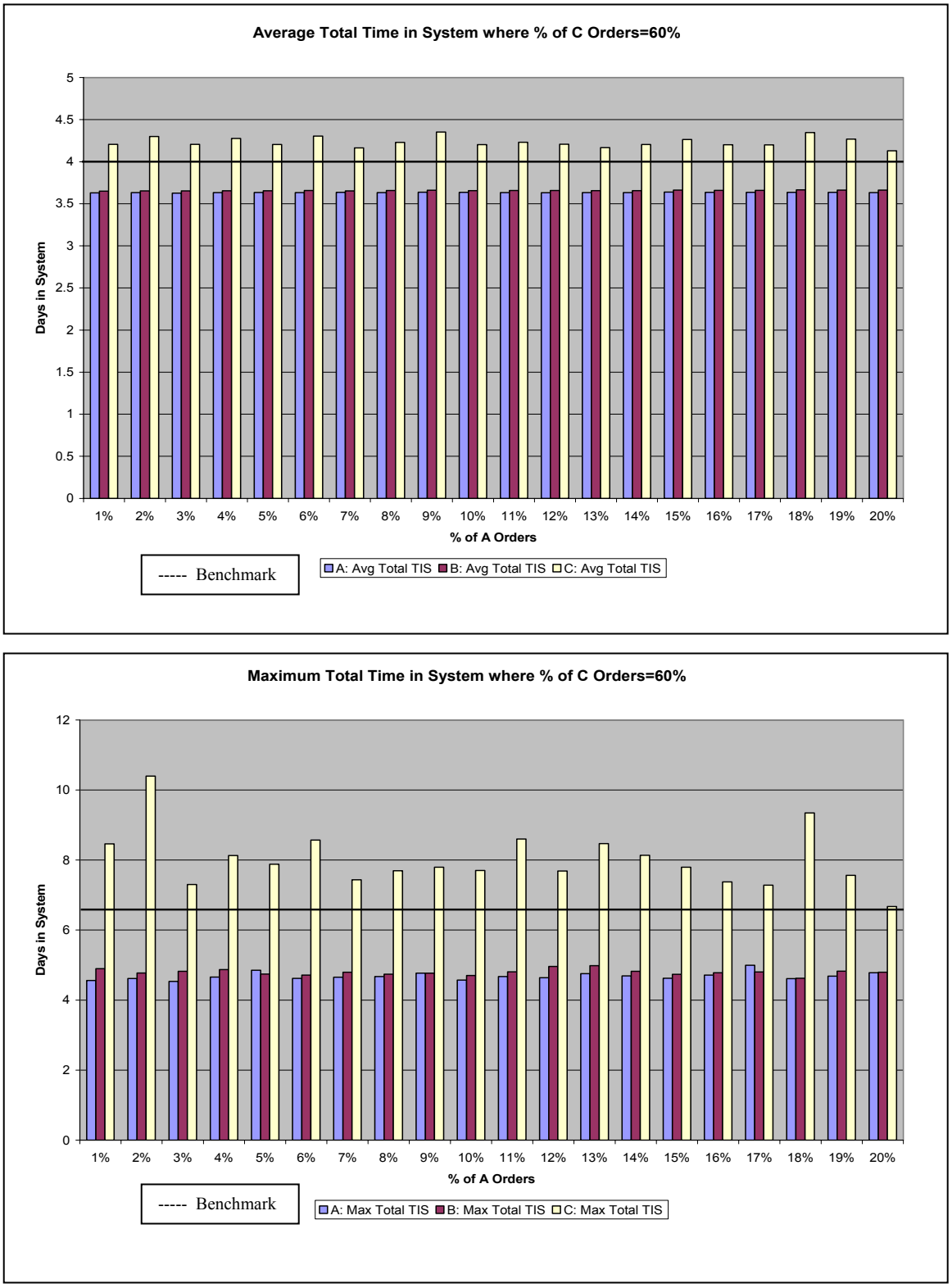


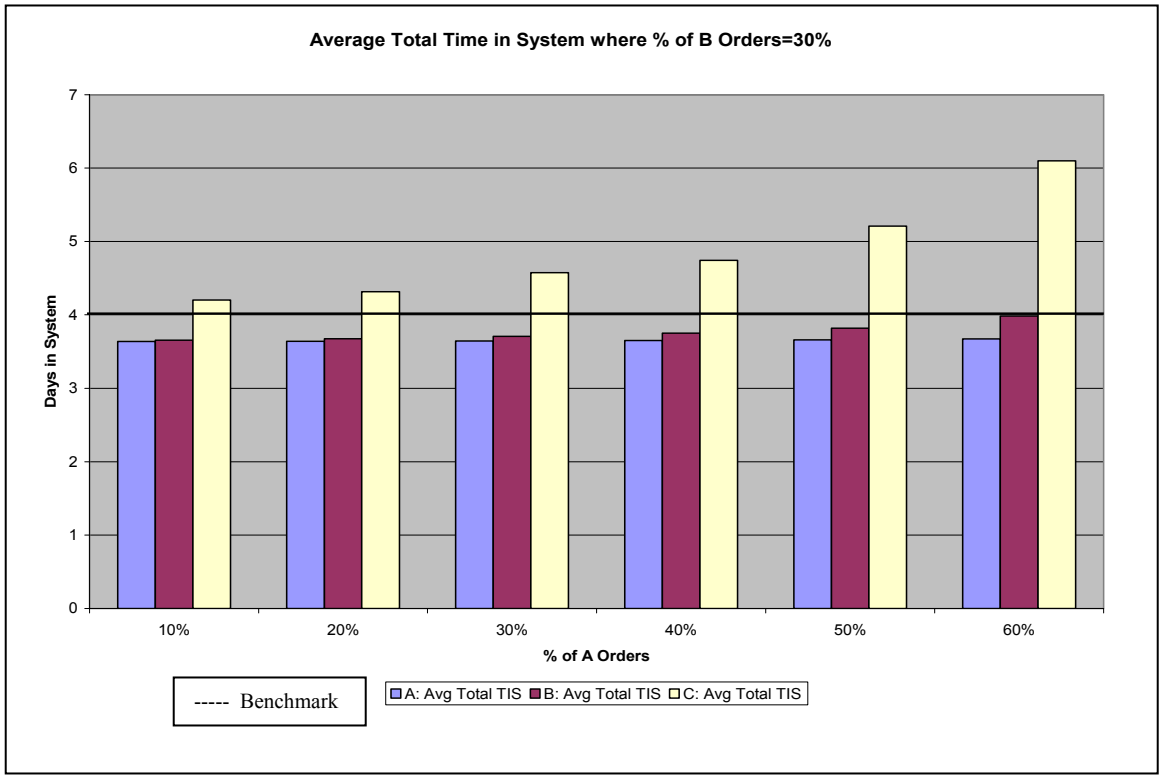
Figure 5.3: The Average and Maximum Total Time in System Holding the Percentage of C Priority Orders Constant at 60%

5.1.2 An Expanded Range of Proportions

I also examined the effects of prioritization on proportions outside of the ranges of A: 1-20%, B: 20-40%, and C: 55-70%, for companies whose proportion of orders from top tier customers to bottom tier customers is much higher. In this set of simulation runs I held the percentage of B priority orders constant at 30% and varied the percentage of A and C priority between the ranges of 10-60% and 10-60% respectively.

Figure 5.4 shows the results of this analysis, where the relationship between the percentage of customers in the top tier and the time in system for the bottom tier customers is more obvious. The average time in system for A and B priority customers is always lower than in the benchmark case, and C priority customers are always in the system longer. However, for the maximum time in system, B priority customers are also in the system longer than in the benchmark when the percentage of A orders is 60%. Furthermore, the relationship between time in system (both average and maximum) and the proportion of A orders has an exponential form. This is most obvious of the C priority orders in the graphs.

The implication of this analysis for manager is that as long as the number of A orders is small, prioritization does not have that adverse of an effect on C orders. However, as the percentage of A orders increase, managers need to be concerned with how long it takes C orders to get through the system, and either set different priority rules to counter this effect, or set customer expectations of lead time accordingly.



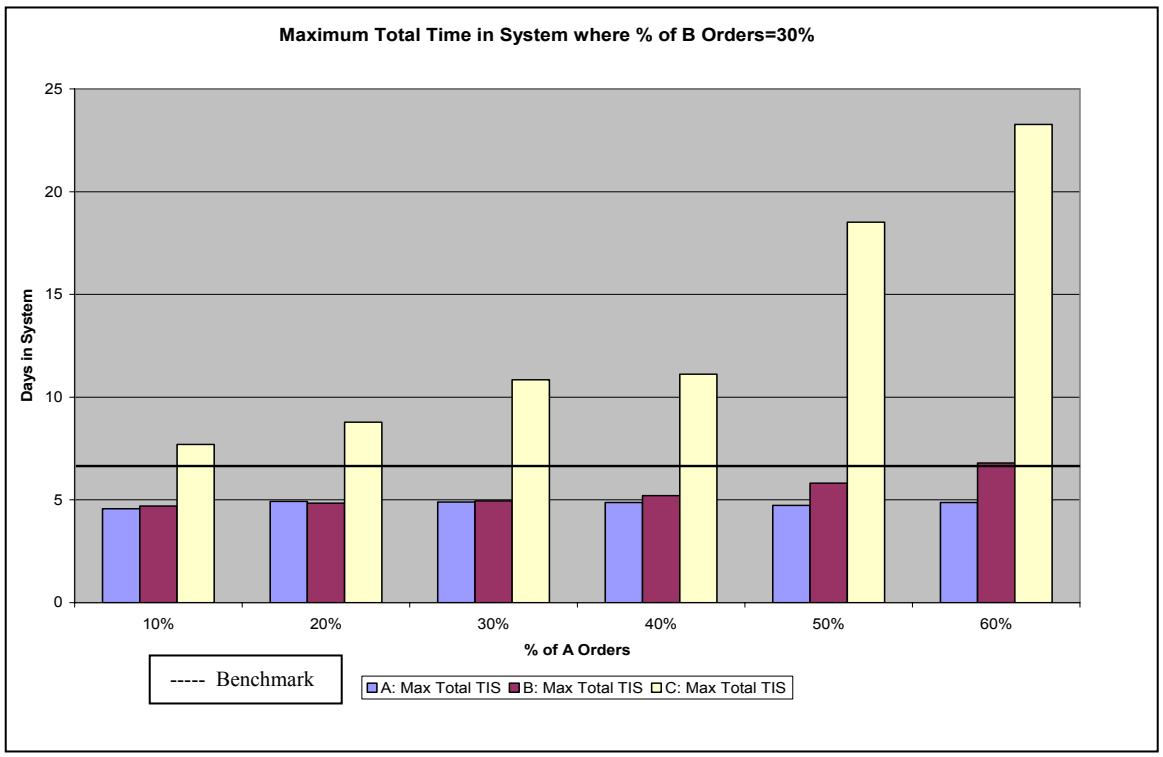
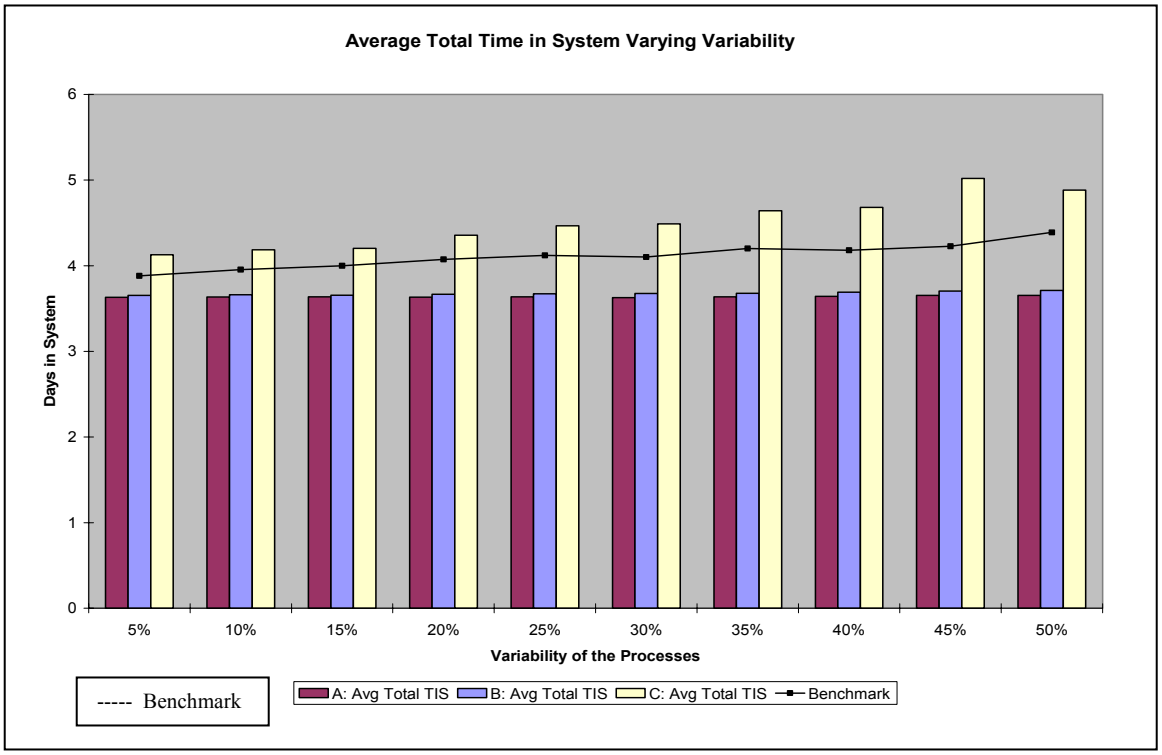


Figure 5.4: Average and Maximum Total Time in System
Holding the Percentage of B Priority Orders Constant at 30%
With a Wider Range of A Priority Orders

5.2 Varying the Variability of the Processes

The second group of analyses I performed focuses on the implications of customer prioritization when different levels of variability exist in the order fulfillment process. Therefore, I examined the effects when variability of each of the processes varies from 5%-50%. For this examination I chose the scenario where the percentage of B priority orders is 30%, since that is the situation I studied in detail with the varying proportions of customer segments. I chose the case where A priority orders are 15% and C priority orders are 55%. The expectation of this analysis was that as the variability of the system increases, the longer it would take all orders to get through the system, but have the most significant impact on the bottom tier customers.

The results of this analysis can be seen in Figure 5.5. The variability of the system seems to not have a significant impact on the average time in system of A, B, or C priority customers. As the variability increases, the average time in system does as well, however, all of the A and B priority customer averages are under the benchmark average, and the C priority customer average is just at or under five days, which is only one day longer than the benchmark case. However, the maximum time in system for C priority customers is highly volatile, which implies that companies with that much variability are going to have a difficult time setting lead time expectations for C priority customers.



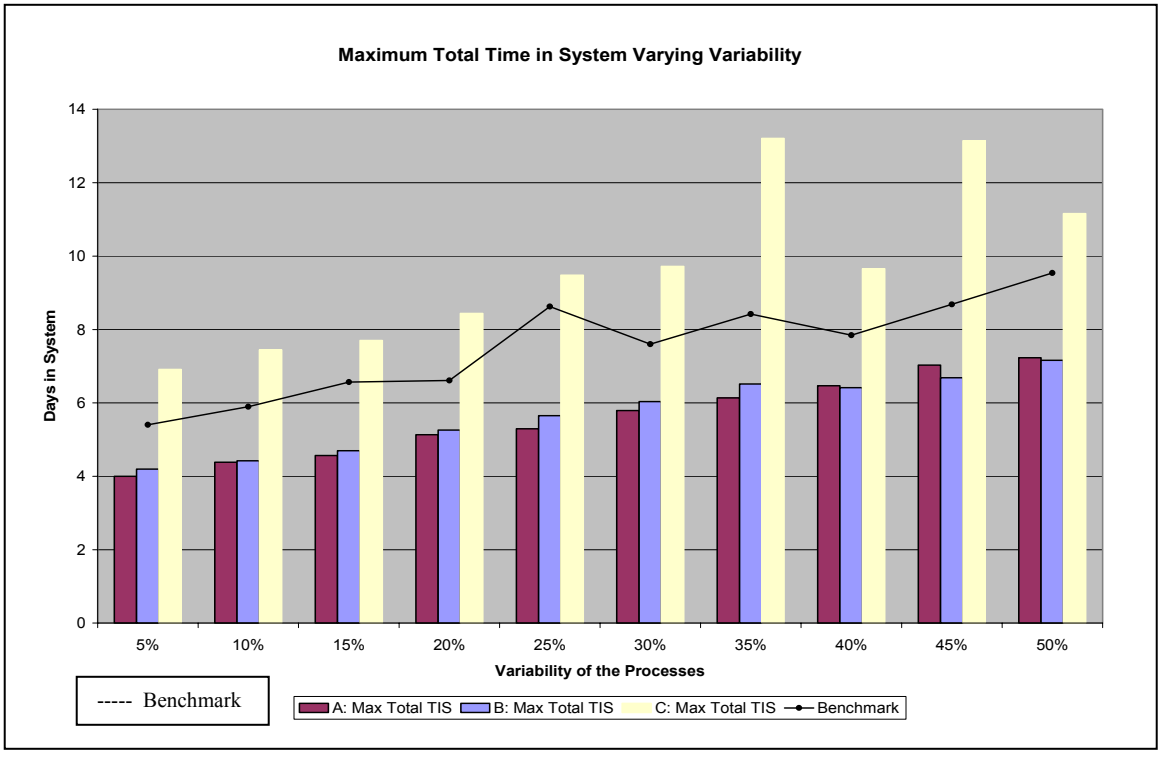
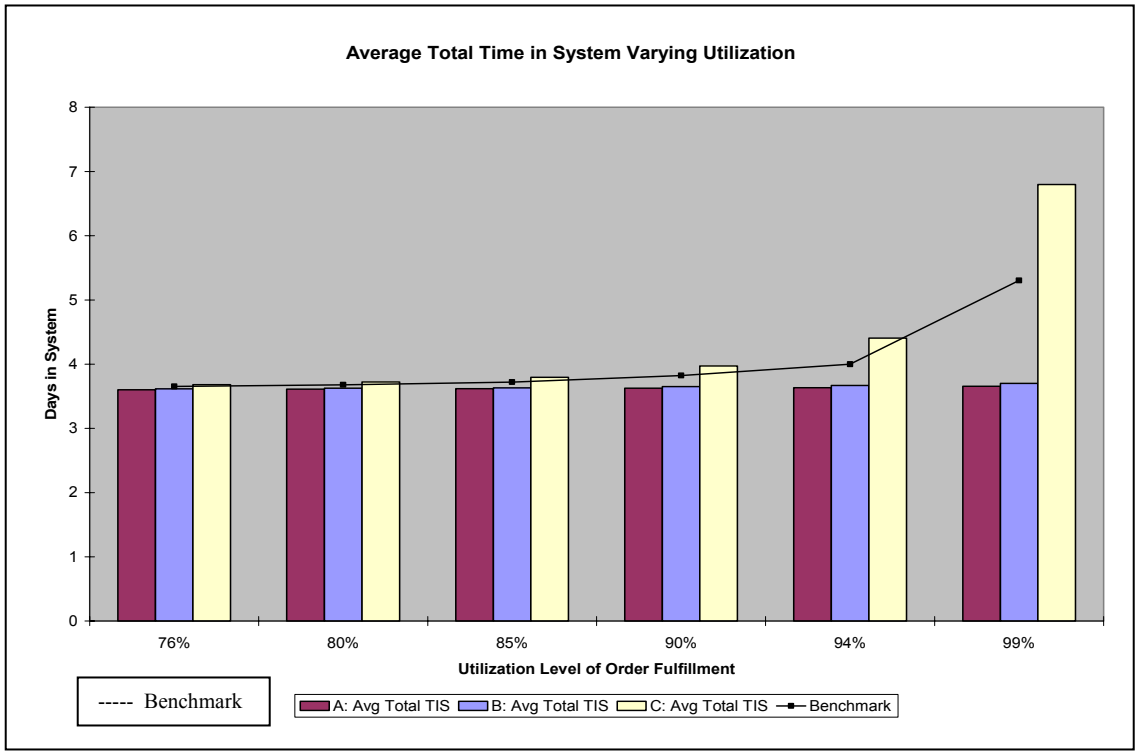


Figure 5.5: Average and Maximum Total Time in System
Holding the Percentage of A Orders Constant at 15%
And Varying the Variability of the Processes

5.3 Varying the Utilization Level of Order Fulfillment

The final analysis I did with the simulation scenarios looks at the effects of varying the utilization of the system. One would expect that as the utilization of the system increases, C priority orders are going to take longer to get through the system. In order to demonstrate the order fulfillment process operating at various capacities, I changed the number of orders arriving of all categories of customers, once again looking at the case where the percentage of orders in A is 15%, in B is 30%, and in C is 55%.

As shown in Figure 5.6, I found that while the average and maximum time in system for A and B priority customers remain largely unaffected, the average and maximum time in system for C priority customers mirror an exponential curve. The maximum time in system for C priority customers follows an exponential curve more closely than the average time in system. This shows that the more closely to capacity a company operates, the more C priority customers will suffer with regards to lead time. This will have an especially negative impact if the lead time is set with a C priority customer during a time of low utilization, because as utilization increases, this lead time will be met less often and with a greater variance, thereby increasing the dissatisfaction of the C customer whose expectations are not being met.



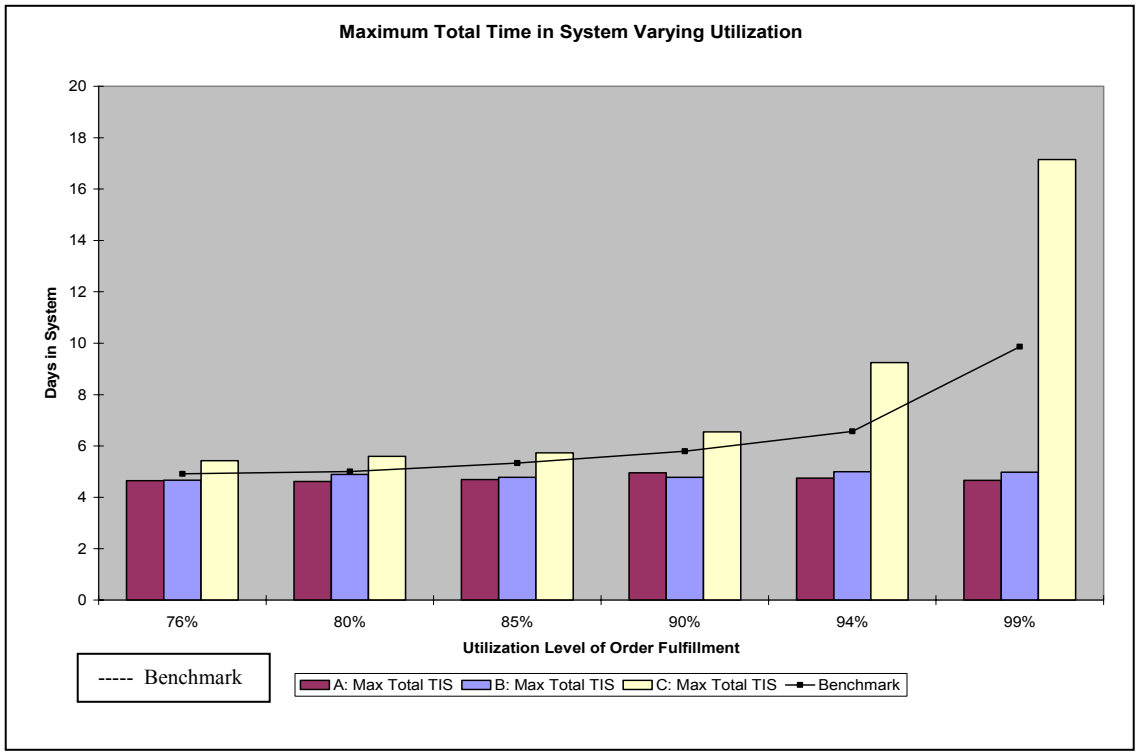


Figure 5.6: Average and Maximum Total Time in System
Holding the Percentage of A Orders Constant at 15%
And Varying the Utilization Level of Order Fulfillment

5.4 Significance of Results

With the various scenarios that I examined, and the limitless scenarios that remain unexamined, it is important for managers to compare their order fulfillment process and customer segmentation policies to the various scenario analyses and draw conclusions about how the data relates to their situation. Depending on the situation of the company with regards to priority management, companies will have different reactions to the data. The goal is to use customer segmentation to increase the overall profitability of the company.

What this means is that regardless of how companies compare to the data, they can learn some lesson from the research. For some companies this may mean realizing that priorities have implications, and therefore should not be assigned on an ad hoc basis. Or, for other companies, this research may show that current prioritization practices could be improved given the state of the order fulfillment process or the proportion of customers necessary in each segment. Furthermore, for other companies, this research may bring about the realization that prioritization practices are in order, but customer expectations of lead time are not being set appropriately.

Given that this research revolves around the cost trade-off of customer segmentation, companies need to assess whether their current prioritization practices are working toward the overall profitability of the company. Therefore, companies should examine the cost implications of prioritization. For example, some companies may be more heavily reliant on top tier customers, in which case, it is more important to adjust bottom tier customer expectations of lead time than to adjust prioritization practices to shorten the bottom tier time in system. On the other hand, if top tier customers are

segmented based on market knowledge, for instance, and bottom tier customers represent most of the orders, perhaps it would be more important to adjust prioritization practices and get bottom tier orders out more quickly. In this case, top tier customers could receive an alternate benefit from the company other than a shortened lead time enacted through order fulfillment prioritization. This shows that prioritization should be adjusted to improve the overall profitability of the company by examining the importance of customer prioritization to customer segments.

CHAPTER 6

CONCLUSION

6.1 Summary

With the recent trend to use customer segmentation in various ways throughout the company, more companies are using a formal approach to segmenting customers in order to provide top customers with better service. Research has shown that providing better service to top customers has more of an impact on the profitability of the company than providing better service to lower-tier customers. Along with this trend is the increased awareness of customer relationship management through supply chain management advances. Customer relationship management stresses the importance of identifying criteria for categorizing customers and establishing guidelines to determine to what degree this differentiation should occur in the product and service agreement.

Once customers are segmented, one way to provide better service to the top-tier customers is by servicing them more quickly, which can be done by assigning priorities to the different tiers. I therefore studied the effects of this prioritization on the lead time of all customers. In an attempt to cover a breadth of company order fulfillment processes and understand which parameters have the greatest effect on lead times, I ran various

scenario analyses with different proportions of customers in each tier, different variability of processes, and different utilization of the system.

The results show that with varying proportions of customers (or orders with regard to volume) in each tier that there is not a strong correlation between proportion and lead time within the ranges of top-tier: 1-20%, middle-tier: 30-40%, and bottom-tier: 55-70%. In this case, top- and middle-tier customers always have an average and maximum time in system lower than that of a first-in first-out system, and the bottom-tier customers always take longer in the system. However, when the proportion of top-tier customers is higher (as would be the case when top-tier customers account for a large volume of orders), the average and maximum time in system generally follows an exponential curve for all customer tiers. In the variability analysis I found that the average time in system is not significantly impacted by variability in the system, and that variability makes the maximum time in system for the bottom-tier customers extremely inconsistent. With regards to utilization the bottom-tier customers are most affected, and the average and maximum time in system grow exponentially the higher the utilization of the system.

For managers, they should use these results to compare with their processes and practices, and make decisions and take actions to improve the overall profitability of the company. These decisions will be different for all companies, depending on how where they fall in relation to the data. Furthermore, the actions could consist of changing the proportions of customers in each segmentation, changing the prioritization rules in order

fulfillment, or adjusting customer expectations of lead time, as set in the PSA through customer relationship management.

6.2 Related Future Research

Given the differences that exist between companies with regards to segmenting customers, the main future research areas that exist are for companies to examine the study more in depth with their own data. There exists such a wide variety of practices for how many segments exist, what criteria is used to put the customers into the categories, the decision rules that exist if prioritization is used to provide a higher service level, and the variability of different processes throughout order fulfillment, that I could only scratch the surface of the research in this area. Therefore, it is now up to companies to compare their systems to the ones I studied, and use the information as a tool to improve customer segmentation practices.

With the data that already exists from my simulation runs, more analyses could be performed. Through the simulation analyses I collected data pertaining to the minimum time in system, as well as the number of orders waiting at each process. These numbers could be analyzed to further show the implications of customer prioritization on lead time.

Another area of future research is a model development to better show the impact of customer purchase volume. The current model has proportions of top tier, middle tier, and bottom tier customers that represent either the number of customers or the number of

orders from each tier. An interesting addition to this study would be to examine the affects when there is a small proportion of top tier customers who order a large volume but do not order frequently. This would mean that the proportion of top tier customers would be relatively small, but the order would take longer at some stages in the order fulfillment process.

Similarly, future research exists in re-designing the simulation to model an order fulfillment system where not all of the customer tiers have to go through the same processes. For example, this new model might exclude the credit check for top-tier customers, because this step may not be necessary every time an order is placed. A re-design of the model would be an interesting development of this research to measure the effects on customer prioritization and lead times.

6.3 Research Conclusion

The goal of this research was to show the effects of prioritization on lead time. Through the study I developed a simulation that can be used for future studies in supply chain management. The simulation shows the impact of different system variables on lead time in the order fulfillment process, including having different proportions of tiered-customers, different variability in processes, and different utilization of the system. Furthermore, this simulation is a tool that managers can use to provide more specific insight into their own processes and aid in priority management. There are limitations on the study I have completed, and I am not suggesting this data is applicable to all companies; however, the data shows how prioritization can matter. It is now up to companies to use the data from the study, as well as the simulation tool, to make decisions on how to most optimally prioritize customers to improve the overall profitability of the company.

BIBLIOGRAPHY

Badgett, M., Stone, M., 2005. "Multidimensional segmentation at work: Driving an operational model that integrates customer segmentation with customer management." *Journal of Targeting, Measurement & Analysis for Marketing* 13, 103-122.

Bowersox, David J., Closs, David J., 1989. "Simulation in Logistics: A review of present practice and a look to the future." *Journal of Business Logistics* 10, 133-148.

Brown, K.L., Inman, R.A., Calloway, J.A., 2001. "Measuring the effects of inventory inaccuracy in MRP inventory and delivery performance." *Production, Planning and Control* 12, 46-57.

Fleisch, E., Tellkamp, C., 2005. "Inventory inaccuracy and supply chain performance: a simulation study of a retail supply chain." *International Journal of Production Economics* 95, 373-385.

Lambert, Douglas M. *Supply Chain Management: Processes, Partnerships, Performance*. Supply Chain Management Institute: Sarasota, Florida, 2004.

Kelton, D.W., Sadowski, R.P., Sturrock, D.T., 2003. *Simulation with Arena, Third Edition, International Edition 2003*. McGraw-Hill, 2003.

Shang, J.S., Li, S., Tadikamalia, P., 2004. "Operational design of a supply chain system using the Taguchi method, response surface methodology, simulation, and optimization." *International Journal of Production Research* 42, 3823-3849.

Swaminathan, J.M., Smith, S.F., Sadeh, N.M., 1998. "Modeling supply chain dynamics: A multiagent approach." *Decision Sciences* 29, 607-632.

Venkateswaran, J., Son, Y.J., 2004. "Impact of modeling approximations in supply chain analysis – an experimental study." *International Journal of Production Research* 42, 2971-2992.

Zeithaml, V., Rust, R., Lemon, K., 2001. "The Customer Pyramid: Creating and Serving Profitable Customers." *California Management Review* 43, 118-144.

APPENDICES

1. Simulation Data for the Benchmark Case for Varying the Proportions of A, B, and C Priority Orders

A items %	33.33%
A TBA	0.1
B items %	33.33%
B TBA	0.1
C items	33.33%
C TBA	0.1
20 Runs	
Number In	5704
Number Out	5696
Total Percent Out	99.86%
Number In A	1914
Number Out A	1908
Percent Out A	99.69%
Number In B	1894
Number Out B	1895
Percent Out B	100.05%
Number In C	1896
Number Out C	1893
Percent Out C	99.84%
Avg Wait Time: A	0.4228
Min Wait Time: A	0
Max Wait Time: A	2.6806
Avg Wait Time: B	0.4221
Min Wait Time: B	0
Max Wait Time: B	2.623
Avg Wait Time: C	0.4254
Min Wait Time: C	0
Max Wait Time: C	2.611
Avg Total Time in System: A	3.9979
Min Total Time in System: A	2.5959
Max Total Time in System: A	6.5303
Avg Total Time in System: B	3.9977
Min Total Time in System: B	2.5761
Max Total Time in System: B	6.5557
Avg Total Time in System: C	4.0018
Min Total Time in System: C	2.5434
Max Total Time in System: C	6.622
Avg Number Waiting: Credit Check	2.6089
Min Number Waiting: Credit Check	0
Max Number Waiting: Credit Check	20
Avg Number Waiting: Order Picking	2.1125
Min Number Waiting: Order Picking	0
Max Number Waiting: Order Picking	23
Avg Number Waiting: Order Processing	8.1902
Min Number Waiting: Order Processing	0
Max Number Waiting: Order Processing	82
Instantaneous Utilization: Credit Checkers	0.9439
Instantaneous Utilization: Order Picker	0.9492
Instantaneous Utilization: Order Processor	0.9453

2. Simulation Data for Holding the Percentage of A Priority Orders Constant

A items %	10%	10%	10%	10%	10%	10%
A TBA	0.3333333	0.3333333	0.3333333	0.3333333	0.3333333	0.3333333
B items %	30%	29%	28%	27%	26%	25%
B TBA	0.111111111	0.114942529	0.119047619	0.12345679	0.128205128	0.133333333
C items	60%	61%	62%	63%	64%	65%
C TBA	0.055555556	0.054644809	0.053763441	0.052910053	0.052083333	0.051282051
20 Runs						
Number In	5690	5705	5727	5721	5685	5734
Number Out	5686	5702	5715	5713	5683	5731
Total Percent Out	99.93%	99.95%	99.79%	99.86%	99.96%	99.95%
Number In A	563	571	573	572	565	579
Number Out A	564	572	571	572	567	579
Percent Out A	100.18%	100.18%	99.65%	100.00%	100.35%	100.00%
Number In B	1708	1650	1606	1551	1479	1439
Number Out B	1711	1647	1606	1551	1476	1438
Percent Out B	100.18%	99.82%	100.00%	100.00%	99.80%	99.93%
Number In C	3419	3484	3548	3598	3641	3716
Number Out C	3411	3483	3538	3590	3640	3714
Percent Out C	99.77%	99.97%	99.72%	99.78%	99.97%	99.95%
Avg Wait Time: A	0.05680309	0.05715807	0.05858157	0.05743051	0.0569511	0.0588646
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2788	0.2984	0.2899	0.3172	0.3081	0.2853
Avg Wait Time: B	0.07955203	0.0795643	0.08182516	0.08069874	0.07527168	0.07928619
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.487	0.5385	0.4533	0.5566	0.5204	0.4957
Avg Wait Time: C	0.628	0.6462	0.7471	0.696	0.5853	0.6957
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	3.6229	4.0386	5.0396	3.6526	3.566	3.7294
Avg Total Time in System: A	3.6368	3.6369	3.6355	3.6332	3.6292	3.6374
Min Total Time in System: A	2.5328	2.6825	2.5877	2.5556	2.6463	2.6607
Max Total Time in System: A	4.5707	4.9756	4.5873	4.6217	4.7136	4.8694
Avg Total Time in System: B	3.6552	3.6557	3.6575	3.6562	3.6498	3.6545
Min Total Time in System: B	2.5751	2.4977	2.5689	2.546	2.5969	2.588
Max Total Time in System: B	4.7004	4.6986	4.925	4.7592	4.7581	4.9261
Avg Total Time in System: C	4.2028	4.2221	4.3236	4.2722	4.1619	4.2733
Min Total Time in System: C	2.7264	2.6218	2.5782	2.5788	2.5729	2.6792
Max Total Time in System: C	7.7027	7.8886	8.8859	8.0213	7.3438	7.7218
Avg Number Waiting: Credit Check	2.6148	2.6987	3.2476	2.8065	2.5775	3.0017
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	20	17	25	20	15	32
Avg Number Waiting: Order Picking	1.9965	1.99	2.3144	2.3253	1.8163	2.3931
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	20	22	23	29	25	27
Avg Number Waiting: Order Processing	7.68	8.1147	9.4268	9.0252	7.6699	9.0652
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	50	68	64	74	57	56
Instantaneous Utilization: Credit Checkers	0.9431	0.9459	0.9487	0.9476	0.9419	0.9503
Instantaneous Utilization: Order Picker	0.9481	0.9503	0.9531	0.9521	0.9468	0.9554
Instantaneous Utilization: Order Processor	0.9436	0.9454	0.949	0.9488	0.9426	0.9504

A items %	10%	10%	10%	10%	10%
A TBA	0.3333333	0.3333333	0.3333333	0.3333333	0.3333333
B items %	24%	23%	22%	21%	20%
B TBA	0.138888889	0.144927536	0.151515152	0.158730159	0.166666667
C items	66%	67%	68%	69%	70%
C TBA	0.050505051	0.049751244	0.049019608	0.048309179	0.047619048
20 Runs					
Number In	5697	5703	5725	5702	5686
Number Out	5692	5702	5720	5706	5692
Total Percent Out	99.91%	99.98%	99.91%	100.07%	100.11%
Number In A	568	571	572	569	568
Number Out A	568	570	573	569	568
Percent Out A	100.00%	99.82%	100.17%	100.00%	100.00%
Number In B	1371	1312	1253	1182	1138
Number Out B	1371	1311	1255	1181	1140
Percent Out B	100.00%	99.92%	100.16%	99.92%	100.18%
Number In C	3758	3820	3900	3951	3980
Number Out C	3753	3821	3892	3956	3984
Percent Out C	99.87%	100.03%	99.79%	100.13%	100.10%
Avg Wait Time: A	0.05694047	0.05785241	0.05823728	0.05732648	0.05710873
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.2877	0.3219	0.2667	0.2834	0.3717
Avg Wait Time: B	0.07551455	0.0759504	0.07606589	0.07360877	0.07211648
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.4874	0.5891	0.4554	0.4636	0.4547
Avg Wait Time: C	0.6055	0.6073	0.6118	0.607	0.5396
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.9113	3.4876	4.3586	3.7775	2.937
Avg Total Time in System: A	3.6321	3.6343	3.635	3.6354	3.6311
Min Total Time in System: A	2.513	2.6227	2.6564	2.6694	2.5459
Max Total Time in System: A	4.7909	4.6897	4.6287	4.7656	4.7887
Avg Total Time in System: B	3.6516	3.6515	3.6505	3.6504	3.6468
Min Total Time in System: B	2.3636	2.618	2.499	2.569	2.5384
Max Total Time in System: B	4.6929	4.7912	4.7465	4.7762	4.7517
Avg Total Time in System: C	4.1829	4.1834	4.1883	4.1827	4.1153
Min Total Time in System: C	2.6655	2.6116	2.5184	2.6419	2.6585
Max Total Time in System: C	7.8386	7.4984	8.2381	7.7023	7.0829
Avg Number Waiting: Credit Check	2.6746	2.583	2.9304	2.9175	2.594
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	18	15	22	19	15
Avg Number Waiting: Order Picking	2.1511	2.1247	2.2433	2.0543	2.0408
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	29	22	29	23	24
Avg Number Waiting: Order Processing	7.9723	8.2597	8.2201	8.2382	7.2775
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	70	60	60	75	52
Instantaneous Utilization: Credit Checkers	0.9438	0.9448	0.9484	0.946	0.9442
Instantaneous Utilization: Order Picker	0.9493	0.9495	0.9536	0.9508	0.9485
Instantaneous Utilization: Order Processor	0.9434	0.9457	0.949	0.9451	0.9438

A items %	11%	11%	11%	11%	11%	11%
A TBA	0.3030303	0.3030303	0.3030303	0.3030303	0.3030303	0.3030303
B items %	30%	29%	28%	27%	26%	25%
B TBA	0.111111111	0.114942529	0.119047619	0.12345679	0.128205128	0.133333333
C items	59%	60%	61%	62%	63%	64%
C TBA	0.056497175	0.055555556	0.054644809	0.053763441	0.052910053	0.052083333
20 Runs						
Number In	5694	5722	5695	5706	5700	5672
Number Out	5690	5714	5692	5698	5682	5666
Total Percent Out	99.93%	99.86%	99.95%	99.86%	99.68%	99.89%
Number In A	630	630	632	631	626	625
Number Out A	630	630	632	630	624	625
Percent Out A	100.00%	100.00%	100.00%	99.84%	99.68%	100.00%
Number In B	1700	1647	1594	1539	1478	1407
Number Out B	1699	1645	1595	1540	1480	1404
Percent Out B	99.94%	99.88%	100.06%	100.06%	100.14%	99.79%
Number In C	3364	3445	3469	3536	3596	3640
Number Out C	3361	3439	3465	3528	3578	3637
Percent Out C	99.91%	99.83%	99.88%	99.77%	99.50%	99.92%
Avg Wait Time: A	0.05798756	0.05744535	0.05716527	0.05741546	0.05692847	0.05666948
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.3719	0.2487	0.3163	0.3209	0.3735	0.2643
Avg Wait Time: B	0.08212246	0.08236513	0.07954623	0.07973657	0.07799596	0.07650552
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.5479	0.5577	0.5241	0.5632	0.4955	0.4754
Avg Wait Time: C	0.7012	0.6534	0.06295	0.6409	0.6281	0.5693
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	3.6933	4.9096	3.815	3.696	3.494	3.7993
Avg Total Time in System: A	3.6339	3.6327	3.6332	3.6301	3.6375	3.6308
Min Total Time in System: A	2.6322	2.6266	2.5113	2.6505	2.6917	2.5226
Max Total Time in System: A	4.6271	4.6694	4.6508	4.6363	4.744	4.6333
Avg Total Time in System: B	3.6591	3.6578	3.654	3.6593	3.6553	3.6524
Min Total Time in System: B	2.5418	2.5818	2.5527	2.495	2.5558	2.5321
Max Total Time in System: B	4.7287	4.8095	4.777	4.7017	4.7333	4.6965
Avg Total Time in System: C	4.2777	4.2311	4.2058	4.2171	4.2025	4.1452
Min Total Time in System: C	2.6147	2.714	2.6456	2.6817	2.4332	2.5967
Max Total Time in System: C	7.6601	8.5976	8.1391	7.7776	7.3165	7.7361
Avg Number Waiting: Credit Check	3.1664	2.7918	2.5527	2.7748	2.883	2.4996
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	27	20	23	20	25	17
Avg Number Waiting: Order Picking	2.2309	2.0913	1.9881	2.061	1.9507	1.7831
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	25	23	26	25	23	20
Avg Number Waiting: Order Processing	8.0349	7.9354	7.8992	8.0603	8.1142	7.4492
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	55	80	56	56	63	74
Instantaneous Utilization: Credit Checkers	0.9438	0.9479	0.9435	0.9454	0.9436	0.9398
Instantaneous Utilization: Order Picker	0.9484	0.9529	0.9487	0.9502	0.9476	0.9447
Instantaneous Utilization: Order Processor	0.9425	0.9478	0.9437	0.9444	0.944	0.939

A items %	11%	11%	11%	11%	11%
A TBA	0.3030303	0.3030303	0.3030303	0.3030303	0.3030303
B items %	24%	23%	22%	21%	20%
B TBA	0.138888889	0.144927536	0.151515152	0.158730159	0.166666667
C items	65%	66%	67%	68%	69%
C TBA	0.051282051	0.050505051	0.049751244	0.049019608	0.048309179
20 Runs					
Number In	5692	5699	5698	5716	5700
Number Out	5688	5699	5697	5710	5696
Total Percent Out	99.93%	100.00%	99.98%	99.90%	99.93%
Number In A	616	624	625	620	609
Number Out A	615	624	624	621	609
Percent Out A	99.84%	100.00%	99.84%	100.16%	100.00%
Number In B	1372	1323	1251	1194	1144
Number Out B	1373	1323	1252	1191	1143
Percent Out B	100.07%	100.00%	100.08%	99.75%	99.91%
Number In C	3704	3752	3822	3902	3947
Number Out C	3700	3752	3821	3898	3944
Percent Out C	99.89%	100.00%	99.97%	99.90%	99.92%
Avg Wait Time: A	0.05731695	0.05790503	0.05760809	0.05820485	0.05724505
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.3036	0.3218	0.3045	0.2835	0.289
Avg Wait Time: B	0.07677235	0.07793784	0.07491144	0.07503019	0.07352902
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.5763	0.4951	0.6279	0.6161	0.4486
Avg Wait Time: C	0.612	0.6487	0.6079	0.6102	0.5834
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.785	3.5028	4.4281	3.5906	3.1787
Avg Total Time in System: A	3.6325	3.6363	3.6349	3.6342	3.6269
Min Total Time in System: A	2.5793	2.5881	2.3739	2.4573	2.5505
Max Total Time in System: A	4.6332	4.7056	4.7679	4.67	4.6703
Avg Total Time in System: B	3.6503	3.6518	3.6469	3.6532	3.6495
Min Total Time in System: B	2.4509	2.5363	2.5932	2.5152	2.5908
Max Total Time in System: B	4.8666	4.7732	4.7198	4.7497	4.8271
Avg Total Time in System: C	4.1875	4.2249	4.184	4.1855	4.1612
Min Total Time in System: C	2.6188	2.6753	2.655	2.5651	2.5486
Max Total Time in System: C	7.8689	7.5842	8.2464	7.4472	6.9413
Avg Number Waiting: Credit Check	2.6295	2.8037	2.6572	2.7929	2.5497
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	20	23	19	21	20
Avg Number Waiting: Order Picking	1.9985	2.2192	1.9903	1.9733	2.0599
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	20	24	25	24	20
Avg Number Waiting: Order Processing	8.1828	8.611	8.3473	8.4998	8.2016
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	75	58	81	77	58
Instantaneous Utilization: Credit Checkers	0.9438	0.9459	0.9446	0.9475	0.9444
Instantaneous Utilization: Order Picker	0.9476	0.9499	0.9489	0.9515	0.9492
Instantaneous Utilization: Order Processor	0.9442	0.9451	0.9449	0.9473	0.9443

A items %	12%	12%	12%	12%	12%	12%
A TBA	0.2777778	0.2777778	0.2777778	0.2777778	0.2777778	0.2777778
B items %	30%	29%	28%	27%	26%	25%
B TBA	0.111111111	0.114942529	0.119047619	0.12345679	0.128205128	0.133333333
C items	58%	59%	60%	61%	62%	63%
C TBA	0.057471264	0.056497175	0.055555556	0.054644809	0.053763441	0.052910053
20 Runs						
Number In	5700	5728	5699	5721	5695	5700
Number Out	5692	5716	5693	5724	5693	5699
Total Percent Out	99.86%	99.79%	99.89%	100.05%	99.96%	99.98%
Number In A	689	688	685	695	690	689
Number Out A	688	689	685	696	689	688
Percent Out A	99.85%	100.15%	100.00%	100.14%	99.86%	99.85%
Number In B	1709	1670	1605	1539	1469	1419
Number Out B	1705	1667	1604	1540	1469	1419
Percent Out B	99.77%	99.82%	99.94%	100.06%	100.00%	100.00%
Number In C	3302	3370	3409	3487	3536	3592
Number Out C	3299	3360	3404	3488	3535	3592
Percent Out C	99.91%	99.70%	99.85%	100.03%	99.97%	100.00%
Avg Wait Time: A	0.05830996	0.05994737	0.05722652	0.05954611	0.05774601	0.05822276
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.304	0.3024	0.3053	0.2691	0.3371	0.3081
Avg Wait Time: B	0.08406109	0.08476741	0.08094542	0.08391739	0.08076908	0.07965559
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.6641	0.6455	0.4997	0.5786	0.5898	0.5268
Avg Wait Time: C	0.6718	0.6891	0.6328	0.7031	0.598	0.6237
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	4.3489	4.5831	3.567	5.0422	3.2067	3.4302
Avg Total Time in System: A	3.6356	3.6343	3.6309	3.6412	3.6345	3.6321
Min Total Time in System: A	2.5693	2.4543	2.6843	2.4363	2.4797	2.5939
Max Total Time in System: A	4.6542	4.664	4.637	4.7969	4.6707	4.7473
Avg Total Time in System: B	3.6587	3.6605	3.6571	3.6624	3.6571	3.6555
Min Total Time in System: B	2.4945	2.4662	2.5	2.6638	2.4001	2.5949
Max Total Time in System: B	4.7407	4.8623	4.9612	4.7149	4.8295	4.7929
Avg Total Time in System: C	4.2501	4.2658	4.208	4.2784	4.1746	4.1991
Min Total Time in System: C	2.6224	2.598	2.4989	2.5188	2.6463	2.6348
Max Total Time in System: C	8.2762	8.4798	7.6861	8.9962	7.23	7.3355
Avg Number Waiting: Credit Check	2.7432	2.9346	2.5846	2.81	2.5491	2.7236
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	23	21	15	18	18	23
Avg Number Waiting: Order Picking	2.0431	2.1554	1.8527	2.2366	2.1333	1.9821
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	26	21	20	23	27	19
Avg Number Waiting: Order Processing	7.9005	8.3018	7.8995	8.721	7.3324	7.9288
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	69	68	57	86	47	56
Instantaneous Utilization: Credit Checkers	0.9447	0.9488	0.9444	0.9496	0.9437	0.9454
Instantaneous Utilization: Order Picker	0.949	0.9532	0.9481	0.955	0.9487	0.9502
Instantaneous Utilization: Order Processor	0.9444	0.9485	0.945	0.9491	0.9436	0.9452

A items %	12%	12%	12%	12%	12%
A TBA	0.2777778	0.2777778	0.2777778	0.2777778	0.2777778
B items %	24%	23%	22%	21%	20%
B TBA	0.138888889	0.144927536	0.151515152	0.158730159	0.166666667
C items	64%	65%	66%	67%	68%
C TBA	0.052083333	0.051282051	0.050505051	0.049751244	0.049019608
20 Runs					
Number In	5672	5700	5689	5728	5715
Number Out	5669	5688	5686	5723	5718
Total Percent Out	99.95%	99.79%	99.95%	99.91%	100.05%
Number In A	683	679	687	676	684
Number Out A	682	679	688	677	685
Percent Out A	99.85%	100.00%	100.15%	100.15%	100.15%
Number In B	1369	1317	1251	1213	1142
Number Out B	1367	1318	1252	1211	1142
Percent Out B	99.85%	100.08%	100.08%	99.84%	100.00%
Number In C	3620	3704	3751	3839	3889
Number Out C	3620	3691	3746	3835	3891
Percent Out C	100.00%	99.65%	99.87%	99.90%	100.05%
Avg Wait Time: A	0.05617399	0.05728112	0.05693768	0.05897999	0.05882272
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.2883	0.2837	0.3216	0.3358	0.3125
Avg Wait Time: B	0.07647604	0.07724628	0.07552079	0.07734712	0.07658322
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.4929	0.4731	0.4809	0.5894	0.5325
Avg Wait Time: C	0.5845	0.6095	0.5523	0.6894	0.6219
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.7469	4.2658	3.2344	3.7931	3.3251
Avg Total Time in System: A	3.6316	3.634	3.63	3.6354	3.6355
Min Total Time in System: A	2.6711	2.4867	2.5619	2.6542	2.6059
Max Total Time in System: A	4.6183	4.706	4.7189	4.6582	4.7926
Avg Total Time in System: B	3.6528	3.6546	3.6508	3.6538	3.6529
Min Total Time in System: B	2.5037	2.5495	2.5565	2.5993	2.5629
Max Total Time in System: B	4.8947	4.6899	4.6441	4.7593	4.9301
Avg Total Time in System: C	4.1598	4.1851	4.1291	4.261	4.1975
Min Total Time in System: C	2.5866	2.5882	2.6092	2.5973	2.6965
Max Total Time in System: C	7.7111	8.0945	7.0754	8.0378	7.1548
Avg Number Waiting: Credit Check	2.4991	2.6167	2.5103	2.747	2.8238
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	19	20	19	18	17
Avg Number Waiting: Order Picking	1.7914	1.8233	1.8363	2.3343	2.124
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	20	17	21	22	22
Avg Number Waiting: Order Processing	7.6402	8.4672	7.3172	9.5157	8.466
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	66	77	53	70	57
Instantaneous Utilization: Credit Checkers	0.9404	0.9434	0.9428	0.949	0.9487
Instantaneous Utilization: Order Picker	0.9446	0.9478	0.9479	0.9534	0.9524
Instantaneous Utilization: Order Processor	0.9406	0.9441	0.9432	0.9499	0.9483

A items %	13%	13%	13%	13%	13%	13%
A TBA	0.2564103	0.2564103	0.2564103	0.2564103	0.2564103	0.2564103
B items %	30%	29%	28%	27%	26%	25%
B TBA	0.111111111	0.114942529	0.119047619	0.12345679	0.128205128	0.133333333
C items	57%	58%	59%	60%	61%	62%
C TBA	0.058479532	0.057471264	0.056497175	0.055555556	0.054644809	0.053763441
20 Runs						
Number In	5698	5676	5693	5696	5697	5677
Number Out	5685	5666	5687	5689	5700	5683
Total Percent Out	99.77%	99.82%	99.89%	99.88%	100.05%	100.11%
Number In A	725	732	741	748	739	731
Number Out A	723	733	739	747	741	732
Percent Out A	99.72%	100.14%	99.73%	99.87%	100.27%	100.14%
Number In B	1709	1650	1595	1537	1486	1425
Number Out B	1709	1650	1592	1533	1485	1425
Percent Out B	100.00%	100.00%	99.81%	99.74%	99.93%	100.00%
Number In C	3264	3294	3357	3411	3472	3521
Number Out C	3253	3283	3356	3409	3474	3526
Percent Out C	99.66%	99.67%	99.97%	99.94%	100.06%	100.14%
Avg Wait Time: A	0.05700912	0.05666214	0.05768485	0.05701314	0.05784854	0.05776718
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.3151	0.3193	0.2646	0.2843	0.275	0.2748
Avg Wait Time: B	0.08391199	0.08239664	0.08244918	0.08059903	0.08115669	0.08028681
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.703	0.5779	0.6249	0.5081	0.541	0.5118
Avg Wait Time: C	0.6241	0.6225	0.7074	0.5899	0.6305	0.6083
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	4.3065	4.0894	4.9001	4.1691	3.9476	4.1102
Avg Total Time in System: A	3.633	3.6346	3.6307	3.6321	3.6336	3.6302
Min Total Time in System: A	2.5307	2.6291	2.6239	2.4528	2.4446	2.6418
Max Total Time in System: A	4.8381	4.6456	4.8418	4.7563	4.6603	4.5963
Avg Total Time in System: B	3.6592	3.658	3.6589	3.6552	3.6555	3.6576
Min Total Time in System: B	2.4454	2.4619	2.4633	2.5664	2.5874	2.5982
Max Total Time in System: B	4.7024	4.8285	4.7624	4.983	4.8997	4.7839
Avg Total Time in System: C	4.2021	4.1987	4.2839	4.1669	4.2081	4.1829
Min Total Time in System: C	2.6414	2.4002	2.5547	2.5716	2.5644	2.5751
Max Total Time in System: C	8.1704	7.8479	9.0248	8.4684	7.9528	8.0547
Avg Number Waiting: Credit Check	2.4754	2.637	2.7179	2.5637	2.6457	2.4671
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	14	18	22	18	19	16
Avg Number Waiting: Order Picking	1.8686	1.9641	2.2017	1.6598	2.0106	1.919
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	21	24	29	18	24	26
Avg Number Waiting: Order Processing	7.5021	7.3179	8.5888	7.3002	7.769	7.6438
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	65	63	79	60	55	73
Instantaneous Utilization: Credit Checkers	0.9426	0.9399	0.9427	0.9438	0.9441	0.942
Instantaneous Utilization: Order Picker	0.947	0.9445	0.9474	0.9476	0.9495	0.9463
Instantaneous Utilization: Order Processor	0.9432	0.9393	0.9429	0.9434	0.9452	0.9427

A items %	13%	13%	13%	13%	13%
A TBA	0.2564103	0.2564103	0.2564103	0.2564103	0.2564103
B items %	24%	23%	22%	21%	20%
B TBA	0.138888889	0.144927536	0.151515152	0.158730159	0.166666667
C items	63%	64%	65%	66%	67%
C TBA	0.052910053	0.052083333	0.051282051	0.050505051	0.049751244
20 Runs					
Number In	5679	5718	5709	5686	5716
Number Out	5672	5718	5703	5691	5716
Total Percent Out	99.88%	100.00%	99.89%	100.09%	100.00%
Number In A	743	741	746	745	755
Number Out A	744	744	745	745	754
Percent Out A	100.13%	100.40%	99.87%	100.00%	99.87%
Number In B	1379	1322	1258	1192	1147
Number Out B	1378	1322	1256	1193	1148
Percent Out B	99.93%	100.00%	99.84%	100.08%	100.09%
Number In C	3557	3655	3705	3749	3814
Number Out C	3550	3652	3702	3753	3814
Percent Out C	99.80%	99.92%	99.92%	100.11%	100.00%
Avg Wait Time: A	0.05655998	0.05935953	0.05896151	0.05718868	0.05926338
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.2933	0.3334	0.2966	0.2961	0.2799
Avg Wait Time: B	0.07907179	0.08148918	0.07906816	0.07713953	0.07827726
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.5628	0.5489	0.6785	0.504	0.59
Avg Wait Time: C	0.6343	0.7024	0.6213	0.5847	0.6621
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	4.4926	3.9492	3.7907	3.2448	3.6552
Avg Total Time in System: A	3.6326	3.6355	3.635	3.6341	3.6332
Min Total Time in System: A	2.7186	2.6162	2.5488	2.4843	2.5286
Max Total Time in System: A	4.5575	4.6806	4.7158	4.7157	4.671
Avg Total Time in System: B	3.6551	3.6567	3.6543	3.6525	3.6509
Min Total Time in System: B	2.5773	2.5677	2.5343	2.5748	2.5861
Max Total Time in System: B	4.8006	4.695	4.7561	4.6763	4.835
Avg Total Time in System: C	4.2108	4.2785	4.1984	4.1603	4.2393
Min Total Time in System: C	2.5932	2.7158	2.7236	2.566	2.6807
Max Total Time in System: C	8.4738	7.9522	8.001	7.2271	7.7174
Avg Number Waiting: Credit Check	2.7179	2.8204	2.6755	2.6118	2.767
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	20	19	24	20	22
Avg Number Waiting: Order Picking	2.0884	2.2535	2.1914	1.906	2.3485
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	36	25	24	28	25
Avg Number Waiting: Order Processing	7.9937	9.3131	8.1081	7.7524	8.9694
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	71	64	87	56	63
Instantaneous Utilization: Credit Checkers	0.9412	0.9486	0.946	0.9434	0.9478
Instantaneous Utilization: Order Picker	0.9451	0.9529	0.9506	0.9485	0.9525
Instantaneous Utilization: Order Processor	0.9411	0.9486	0.9464	0.9431	0.9483

A items %	14%	14%	14%	14%	14%	14%
A TBA	0.2380952	0.2380952	0.2380952	0.2380952	0.2380952	0.2380952
B items %	30%	29%	28%	27%	26%	25%
B TBA	0.111111111	0.114942529	0.119047619	0.12345679	0.128205128	0.133333333
C items	56%	57%	58%	59%	60%	61%
C TBA	0.05952381	0.058479532	0.057471264	0.056497175	0.055555556	0.054644809
20 Runs						
Number In	5674	5695	5678	5703	5687	5698
Number Out	5674	5698	5667	5700	5685	5693
Total Percent Out	100.00%	100.05%	99.81%	99.95%	99.96%	99.91%
Number In A	801	795	792	805	797	795
Number Out A	800	796	791	807	796	795
Percent Out A	99.88%	100.13%	99.87%	100.25%	99.87%	100.00%
Number In B	1716	1648	1591	1522	1483	1424
Number Out B	1713	1649	1588	1521	1480	1421
Percent Out B	99.83%	100.06%	99.81%	99.93%	99.80%	99.79%
Number In C	3157	3252	3295	3376	3407	3479
Number Out C	3161	3253	3288	3372	3409	3477
Percent Out C	100.13%	100.03%	99.79%	99.88%	100.06%	99.94%
Avg Wait Time: A	0.05711717	0.0579349	0.0573408	0.0596969	0.05806241	0.05844879
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.3058	0.2885	0.3251	0.4008	0.2887	0.33
Avg Wait Time: B	0.08580008	0.08545329	0.08376097	0.08500026	0.08170804	0.08253142
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.6823	0.5427	0.6591	0.5757	0.5373	0.5786
Avg Wait Time: C	0.638	0.6316	0.6279	0.6597	0.6272	0.6145
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	3.9822	3.4388	3.6576	3.7172	4.0536	3.0564
Avg Total Time in System: A	3.6314	3.6314	3.6372	3.6328	3.6323	3.6335
Min Total Time in System: A	2.6511	2.5762	2.6138	2.6173	2.7003	2.4089
Max Total Time in System: A	4.6115	4.8479	4.6358	4.6626	4.6909	4.6943
Avg Total Time in System: B	3.6597	3.6595	3.6575	3.6609	3.6552	3.6577
Min Total Time in System: B	2.5161	2.5057	2.6263	2.5913	2.5653	2.5142
Max Total Time in System: B	4.7383	4.7865	4.9041	4.7659	4.8184	4.884
Avg Total Time in System: C	4.2145	4.209	4.2035	4.2362	4.2036	4.1901
Min Total Time in System: C	2.5098	2.3976	2.4774	2.6695	2.6261	2.5615
Max Total Time in System: C	7.7345	7.1475	7.3691	7.7164	8.1384	7.1647
Avg Number Waiting: Credit Check	2.5387	2.5622	2.5609	2.8045	2.5297	2.8234
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	18	24	17	24	16	22
Avg Number Waiting: Order Picking	1.7967	1.8222	1.9243	2.0654	2.1594	2.0005
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	22	21	24	21	31	36
Avg Number Waiting: Order Processing	7.3537	7.444	7.4237	7.8229	7.528	7.4069
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	49	53	50	56	58	48
Instantaneous Utilization: Credit Checkers	0.9409	0.9449	0.94	0.9462	0.9425	0.9442
Instantaneous Utilization: Order Picker	0.9446	0.9492	0.9441	0.95	0.947	0.9489
Instantaneous Utilization: Order Processor	0.9408	0.9446	0.9405	0.9451	0.9429	0.9445

A items %	14%	14%	14%	14%	14%
A TBA	0.2380952	0.2380952	0.2380952	0.2380952	0.2380952
B items %	24%	23%	22%	21%	20%
B TBA	0.138888889	0.144927536	0.151515152	0.158730159	0.166666667
C items	62%	63%	64%	65%	66%
C TBA	0.053763441	0.052910053	0.052083333	0.051282051	0.050505051
20 Runs					
Number In	5701	5686	5696	5706	5688
Number Out	5694	5689	5696	5701	5689
Total Percent Out	99.88%	100.05%	100.00%	99.91%	100.02%
Number In A	802	801	801	804	798
Number Out A	801	801	801	803	799
Percent Out A	99.88%	100.00%	100.00%	99.88%	100.13%
Number In B	1376	1305	1250	1184	1129
Number Out B	1374	1304	1251	1184	1131
Percent Out B	99.85%	99.92%	100.08%	100.00%	100.18%
Number In C	3523	3580	3645	3718	3761
Number Out C	3519	3584	3644	3714	3759
Percent Out C	99.89%	100.11%	99.97%	99.89%	99.95%
Avg Wait Time: A	0.05919496	0.05842985	0.05907203	0.05939775	0.05769754
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.3275	0.4366	0.3379	0.3075	0.291
Avg Wait Time: B	0.0810928	0.08061883	0.08043048	0.07971748	0.07615373
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.4995	0.558	0.4959	0.5192	0.4982
Avg Wait Time: C	0.5927	0.5868	0.6212	0.7108	0.5523
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.4549	3.2173	3.255	5.5074	3.4524
Avg Total Time in System: A	3.6339	3.6329	3.6375	3.6331	3.6373
Min Total Time in System: A	2.6574	2.6356	2.6176	2.5632	2.5467
Max Total Time in System: A	4.7275	4.6748	4.6788	4.6825	4.7779
Avg Total Time in System: B	3.658	3.6581	3.657	3.6571	3.6515
Min Total Time in System: B	2.61	2.5333	2.6643	2.5696	2.5907
Max Total Time in System: B	4.7206	4.6604	4.8763	4.8193	4.6782
Avg Total Time in System: C	4.1689	4.1611	4.1978	4.2882	4.1279
Min Total Time in System: C	2.699	2.4776	2.6505	2.4326	2.6757
Max Total Time in System: C	7.9	7.4035	7.1805	9.5521	7.5394
Avg Number Waiting: Credit Check	2.6651	2.6903	2.6438	2.8179	2.5437
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	23	19	17	20	20
Avg Number Waiting: Order Picking	2.0079	1.9817	2.1801	2.4542	1.8315
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	30	24	22	28	20
Avg Number Waiting: Order Processing	7.2016	7.1842	7.9194	9.5507	7.2666
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	52	51	62	88	59
Instantaneous Utilization: Credit Checkers	0.944	0.9439	0.9442	0.9456	0.9428
Instantaneous Utilization: Order Picker	0.9493	0.9481	0.9497	0.9502	0.9476
Instantaneous Utilization: Order Processor	0.9438	0.9426	0.9441	0.9458	0.9432

A items %	15%	15%	15%	15%	15%	15%
A TBA	0.2222222	0.2222222	0.2222222	0.2222222	0.2222222	0.2222222
B items %	30%	29%	28%	27%	26%	25%
B TBA	0.111111111	0.114942529	0.119047619	0.12345679	0.128205128	0.133333333
C items	55%	56%	57%	58%	59%	60%
C TBA	0.060606061	0.05952381	0.058479532	0.057471264	0.056497175	0.055555556
20 Runs						
Number In	5694	5703	5699	5708	5701	5711
Number Out	5692	5700	5696	5706	5699	5699
Total Percent Out	99.96%	99.95%	99.95%	99.96%	99.96%	99.79%
Number In A	853	856	848	852	839	858
Number Out A	854	856	849	851	841	857
Percent Out A	100.12%	100.00%	100.12%	99.88%	100.24%	99.88%
Number In B	1708	1661	1594	1535	1476	1432
Number Out B	1709	1658	1594	1537	1474	1429
Percent Out B	100.06%	99.82%	100.00%	100.13%	99.86%	99.79%
Number In C	3133	3186	3257	3321	3386	3421
Number Out C	3129	3186	3253	3318	3384	3413
Percent Out C	99.87%	100.00%	99.88%	99.91%	99.94%	99.77%
Avg Wait Time: A	0.05984599	0.05900476	0.05947332	0.05960633	0.05991767	0.06001951
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.3071	0.3897	0.3484	0.3345	0.2983	0.2849
Avg Wait Time: B	0.0909	0.088535	0.08723576	0.08768501	0.08659623	0.0861065
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.6587	0.6061	0.6716	0.6092	0.5741	0.5294
Avg Wait Time: C	0.8305	0.6725	0.7376	0.6791	0.6612	0.6867
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	5.4238	3.2898	5.9751	3.6451	3.4784	3.7438
Avg Total Time in System: A	3.6343	3.6334	3.6351	3.6396	3.6341	3.6397
Min Total Time in System: A	2.506	2.4969	2.6504	2.6525	2.6526	2.5329
Max Total Time in System: A	4.7522	4.6932	4.7698	4.6952	4.788	4.6258
Avg Total Time in System: B	3.6663	3.6656	3.6642	3.6619	3.6628	3.6623
Min Total Time in System: B	2.5296	2.5622	2.5602	2.6256	2.5583	2.5702
Max Total Time in System: B	4.9967	4.7527	4.7734	4.8083	4.7574	4.7351
Avg Total Time in System: C	4.4072	4.2484	4.3124	4.2558	4.2376	4.2622
Min Total Time in System: C	2.5421	2.6284	2.6047	2.5026	2.705	2.6752
Max Total Time in System: C	9.2485	7.3266	10.0208	7.4931	7.6238	7.7938
Avg Number Waiting: Credit Check	2.9389	2.8137	2.8334	2.6897	2.6678	2.7189
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	21	22	22	18	17	17
Avg Number Waiting: Order Picking	2.758	1.9744	2.1004	2.0421	2.1174	2.2059
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	39	19	23	19	21	26
Avg Number Waiting: Order Processing	9.2437	7.5968	8.8093	8.1569	7.9719	8.4935
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	67	54	93	59	62	64
Instantaneous Utilization: Credit Checkers	0.9442	0.9461	0.9448	0.9457	0.945	0.9451
Instantaneous Utilization: Order Picker	0.9488	0.9496	0.9494	0.951	0.9499	0.9504
Instantaneous Utilization: Order Processor	0.9435	0.9445	0.9445	0.9461	0.9454	0.9457

A items %	15%	15%	15%	15%	15%
A TBA	0.2222222	0.2222222	0.2222222	0.2222222	0.2222222
B items %	24%	23%	22%	21%	20%
B TBA	0.138888889	0.144927536	0.151515152	0.158730159	0.166666667
C items	61%	62%	63%	64%	65%
C TBA	0.054644809	0.053763441	0.052910053	0.052083333	0.051282051
20 Runs					
Number In	5700	5689	5714	5694	5708
Number Out	5697	5682	5710	5693	5710
Total Percent Out	99.95%	99.88%	99.93%	99.98%	100.04%
Number In A	863	851	858	849	856
Number Out A	863	851	856	851	856
Percent Out A	100.00%	100.00%	99.77%	100.24%	100.00%
Number In B	1370	1311	1263	1194	1143
Number Out B	1369	1308	1264	1194	1144
Percent Out B	99.93%	99.77%	100.08%	100.00%	100.09%
Number In C	3467	3527	3593	3651	3709
Number Out C	3465	3523	3590	3648	3710
Percent Out C	99.94%	99.89%	99.92%	99.92%	100.03%
Avg Wait Time: A	0.05960288	0.0585064	0.06069499	0.05967392	0.06013654
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.3317	0.2828	0.2908	0.2927	0.298
Avg Wait Time: B	0.08320102	0.08091377	0.08238189	0.08118135	0.08048151
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.5511	0.5598	0.5185	0.5418	0.5148
Avg Wait Time: C	0.6251	0.5911	0.6401	0.686	0.6006
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.2957	4.3831	4.7216	4.8164	3.686
Avg Total Time in System: A	3.6366	3.6319	3.6349	3.6348	3.6362
Min Total Time in System: A	2.7109	2.6294	2.604	2.5078	2.5896
Max Total Time in System: A	4.6481	4.7147	4.5964	4.6309	4.8085
Avg Total Time in System: B	3.6584	3.6588	3.6597	3.6577	3.6543
Min Total Time in System: B	2.4051	2.6459	2.3337	2.5521	2.5075
Max Total Time in System: B	4.7841	4.953	4.7222	4.8427	4.7724
Avg Total Time in System: C	4.2017	4.1666	4.2168	4.2624	4.1759
Min Total Time in System: C	2.5327	2.4538	2.5622	2.5554	2.5619
Max Total Time in System: C	7.1624	8.1578	8.6816	8.6156	7.3752
Avg Number Waiting: Credit Check	2.5936	2.5745	2.8265	2.9442	2.7441
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	19	16	21	22	29
Avg Number Waiting: Order Picking	1.9689	1.8954	2.0071	2.2896	2.0553
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	22	20	22	35	24
Avg Number Waiting: Order Processing	7.7709	7.3708	8.2075	8.8793	7.7311
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	51	75	76	75	59
Instantaneous Utilization: Credit Checkers	0.944	0.9432	0.947	0.9444	0.947
Instantaneous Utilization: Order Picker	0.9497	0.9469	0.9519	0.9492	0.9513
Instantaneous Utilization: Order Processor	0.9447	0.9423	0.9471	0.943	0.9475

3. Simulation Data for Holding the Percentage of B Priority Orders Constant

A items %	2%	4%	6%	8%	10%
A TBA	1.6666667	0.8333333	0.5555556	0.4166667	0.3333333
B items %	30%	30%	30%	30%	30%
B TBA	0.111111111	0.111111111	0.111111111	0.111111111	0.111111111
C items	68%	66%	64%	62%	60%
C TBA	0.049019608	0.050505051	0.052083333	0.053763441	0.055555556
20 Runs					
Number In	5717	5732	5698	5682	5690
Number Out	5713	5730	5687	5676	5686
Total Percent Out	99.93%	99.97%	99.81%	99.89%	99.93%
Number In A	113	228	348	458	563
Number Out A	113	228	346	457	564
Percent Out A	100.00%	100.00%	99.43%	99.78%	100.18%
Number In B	1726	1721	1712	1703	1708
Number Out B	1727	1722	1714	1704	1711
Percent Out B	100.06%	100.06%	100.12%	100.06%	100.18%
Number In C	3878	3783	3638	3521	3419
Number Out C	3873	3780	3627	3515	3411
Percent Out C	99.87%	99.92%	99.70%	99.83%	99.77%
Avg Wait Time: A	0.05597002	0.05545896	0.05565875	0.05495894	0.05680309
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.3158	0.2446	0.2713	0.3119	0.2788
Avg Wait Time: B	0.07046937	0.07430106	0.07463002	0.07718534	0.07955203
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.4345	0.4181	0.4162	0.4601	0.487
Avg Wait Time: C	0.6019	0.6872	0.653	0.6208	0.628
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.4781	3.9811	4.0152	3.3121	3.6229
Avg Total Time in System: A	3.6297	3.6309	3.6363	3.6304	3.6368
Min Total Time in System: A	2.7644	2.6936	2.5473	2.6034	2.5328
Max Total Time in System: A	4.4996	4.61	4.65	4.5499	4.5707
Avg Total Time in System: B	3.6471	3.651	3.6518	3.6532	3.6552
Min Total Time in System: B	2.5579	2.5909	2.5334	2.4227	2.5751
Max Total Time in System: B	4.6963	4.6602	4.9244	4.8277	4.7004
Avg Total Time in System: C	4.1779	4.264	4.228	4.1966	4.2028
Min Total Time in System: C	2.3465	2.675	2.6024	2.5854	2.7264
Max Total Time in System: C	7.2051	7.9244	8.0218	7.2398	7.7027
Avg Number Waiting: Credit Check	2.644	3.0364	2.7154	2.7743	2.6148
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	20	22	19	21	20
Avg Number Waiting: Order Picking	2.1564	2.4617	2.1783	2.1361	1.9965
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	23	29	26	31	20
Avg Number Waiting: Order Processing	8.2404	9.0207	8.5346	7.518	7.68
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	64	56	70	58	50
Instantaneous Utilization: Credit Checkers	0.9476	0.9509	0.9438	0.9416	0.9431
Instantaneous Utilization: Order Picker	0.9522	0.9547	0.9483	0.9457	0.9481
Instantaneous Utilization: Order Processor	0.9485	0.9509	0.9444	0.941	0.9436

A items %	12%	14%
A TBA	0.2777778	0.2380952
B items %	30%	30%
B TBA	0.111111111	0.111111111
C items	58%	56%
C TBA	0.057471264	0.05952381
20 Runs		
Number In	5700	5674
Number Out	5692	5674
Total Percent Out	99.86%	100.00%
Number In A	689	801
Number Out A	688	800
Percent Out A	99.85%	99.88%
Number In B	1709	1716
Number Out B	1705	1713
Percent Out B	99.77%	99.83%
Number In C	3302	3157
Number Out C	3299	3161
Percent Out C	99.91%	100.13%
Avg Wait Time: A	0.05830996	0.05711717
Min Wait Time: A	0	0
Max Wait Time: A	0.304	0.3058
Avg Wait Time: B	0.08406109	0.08580008
Min Wait Time: B	0	0
Max Wait Time: B	0.6641	0.6823
Avg Wait Time: C	0.6718	0.638
Min Wait Time: C	0	0
Max Wait Time: C	4.3489	3.9822
Avg Total Time in System: A	3.6356	3.6314
Min Total Time in System: A	2.5693	2.6511
Max Total Time in System: A	4.6542	4.6115
Avg Total Time in System: B	3.6587	3.6597
Min Total Time in System: B	2.4945	2.5161
Max Total Time in System: B	4.7407	4.7383
Avg Total Time in System: C	4.2501	4.2145
Min Total Time in System: C	2.6224	2.5098
Max Total Time in System: C	8.2762	7.7345
Avg Number Waiting: Credit Check	2.7432	2.5387
Min Number Waiting: Credit Check	0	0
Max Number Waiting: Credit Check	23	18
Avg Number Waiting: Order Picking	2.0431	1.7967
Min Number Waiting: Order Picking	0	0
Max Number Waiting: Order Picking	26	22
Avg Number Waiting: Order Processing	7.9005	7.3537
Min Number Waiting: Order Processing	0	0
Max Number Waiting: Order Processing	69	49
Instantaneous Utilization: Credit Checkers	0.9447	0.9409
Instantaneous Utilization: Order Picker	0.949	0.9446
Instantaneous Utilization: Order Processor	0.9444	0.9408

A items %	2%	4%	6%	8%	10%
A TBA	1.6666667	0.8333333	0.5555556	0.4166667	0.3333333
B items %	30%	30%	30%	30%	30%
B TBA	0.111111111	0.111111111	0.111111111	0.111111111	0.111111111
C items	68%	66%	64%	62%	60%
C TBA	0.049019608	0.050505051	0.052083333	0.053763441	0.055555556
40 Runs					
Number In	11711	11730	11655	11710	11696
Number Out	11699	11728	11642	11699	11692
Total Percent Out	99.90%	99.98%	99.89%	99.91%	99.97%
Number In A	233	467	695	944	1168
Number Out A	233	467	695	945	1167
Percent Out A	100.00%	100.00%	100.00%	100.11%	99.91%
Number In B	3509	3533	3509	3513	3511
Number Out B	3509	3531	3505	3511	3511
Percent Out B	100.00%	99.94%	99.89%	99.94%	100.00%
Number In C	7969	7730	7451	7253	7017
Number Out C	7957	7730	7442	7243	7014
Percent Out C	99.85%	100.00%	99.88%	99.86%	99.96%
Avg Wait Time: A	0.05394605	0.05519364	0.05476897	0.05677123	0.05667593
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.3158	0.2559	0.3046	0.3243	0.3137
Avg Wait Time: B	0.06963314	0.07327256	0.07344498	0.17875477	0.08085343
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.4625	0.4223	0.5393	0.5891	0.5545
Avg Wait Time: C	0.5783	0.6318	0.6009	0.6634	0.6511
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	4.1521	5.1464	4.0152	5.0938	6.9707
Avg Total Time in System: A	3.6289	3.6326	3.6319	3.6322	3.6344
Min Total Time in System: A	2.6447	2.5517	2.5473	2.5062	2.5329
Max Total Time in System: A	4.686	4.6781	4.709	4.9567	4.7058
Avg Total Time in System: B	3.6458	3.6497	3.6501	3.6551	3.6565
Min Total Time in System: B	2.4723	2.4172	2.4595	2.4227	2.4995
Max Total Time in System: B	4.8635	4.9548	4.9244	4.8277	4.813
Avg Total Time in System: C	4.1541	4.2075	4.1768	4.2395	4.2271
Min Total Time in System: C	2.3465	2.5085	2.548	2.4469	2.3953
Max Total Time in System: C	8.0691	9.078	8.0218	9.1551	10.8659
Avg Number Waiting: Credit Check	2.6299	2.8397	2.6185	2.7358	2.6458
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	26	23	34	23	23
Avg Number Waiting: Order Picking	2.0959	2.1905	1.9988	2.3035	2.0179
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	23	31	26	31	25
Avg Number Waiting: Order Processing	7.8326	8.2796	7.6943	8.2479	7.9917
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	64	85	70	86	105
Instantaneous Utilization: Credit Checkers	0.9452	0.9478	0.9405	0.9455	0.9444
Instantaneous Utilization: Order Picker	0.9499	0.952	0.9455	0.9503	0.9491
Instantaneous Utilization: Order Processor	0.9455	0.9473	0.9406	0.9454	0.9445

A items %	12%	14%
A TBA	0.2777778	0.2380952
B items %	30%	30%
B TBA	0.111111111	0.111111111
C items	58%	56%
C TBA	0.057471264	0.05952381
40 Runs		
Number In	11702	11703
Number Out	11694	11695
Total Percent Out	99.93%	99.93%
Number In A	1405	1638
Number Out A	1405	1638
Percent Out A	100.00%	100.00%
Number In B	3510	3506
Number Out B	3508	3504
Percent Out B	99.94%	99.94%
Number In C	6787	6559
Number Out C	6781	6553
Percent Out C	99.91%	99.91%
Avg Wait Time: A	0.05811287	0.05888039
Min Wait Time: A	0	0
Max Wait Time: A	0.304	0.3701
Avg Wait Time: B	0.08482376	0.08799191
Min Wait Time: B	0	0
Max Wait Time: B	0.55	0.6823
Avg Wait Time: C	0.6985	0.7032
Min Wait Time: C	0	0
Max Wait Time: C	4.7997	4.6015
Avg Total Time in System: A	3.6335	3.636
Min Total Time in System: A	2.4463	2.5377
Max Total Time in System: A	4.7788	4.8546
Avg Total Time in System: B	3.6604	3.6646
Min Total Time in System: B	2.4874	2.5035
Max Total Time in System: B	4.9144	4.9179
Avg Total Time in System: C	4.2753	4.2788
Min Total Time in System: C	2.5552	2.5098
Max Total Time in System: C	8.803	8.6074
Avg Number Waiting: Credit Check	2.724	2.6908
Min Number Waiting: Credit Check	0	0
Max Number Waiting: Credit Check	24	23
Avg Number Waiting: Order Picking	2.1741	2.0895
Min Number Waiting: Order Picking	0	0
Max Number Waiting: Order Picking	25	29
Avg Number Waiting: Order Processing	8.2918	8.1615
Min Number Waiting: Order Processing	0	0
Max Number Waiting: Order Processing	75	71
Instantaneous Utilization: Credit Checkers	0.9447	0.9445
Instantaneous Utilization: Order Picker	0.9498	0.9494
Instantaneous Utilization: Order Processor	0.9449	0.9453

A items %	20%	30%	40%	50%	60%
A TBA	0.1666667	0.1111111	0.0833333	0.0666667	0.0555556
B items %	30%	30%	30%	30%	30%
B TBA	0.111111111	0.111111111	0.111111111	0.111111111	0.111111111
C items	50%	40%	30%	20%	10%
C TBA	0.066666667	0.083333333	0.111111111	0.166666667	0.333333333
20 Runs					
Number In	5708	5705	5719	5701	5674
Number Out	5710	5703	5713	5689	5669
Total Percent Out	100.04%	99.96%	99.90%	99.79%	99.91%
Number In A	856	1714	2285	2844	3417
Number Out A	856	1714	2285	2839	3417
Percent Out A	100.00%	100.00%	100.00%	99.82%	100.00%
Number In B	1143	1723	1722	1710	1690
Number Out B	1144	1723	1720	1711	1687
Percent Out B	100.09%	100.00%	99.88%	100.06%	99.82%
Number In C	3709	2268	1712	1147	567
Number Out C	3710	2266	1708	1139	565
Percent Out C	100.03%	99.91%	99.77%	99.30%	99.65%
Avg Wait Time: A	0.06106589	0.06800778	0.07604673	0.08368867	0.0967
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.3553	0.3797	0.4612	0.4966	0.6013
Avg Wait Time: B	0.0987	0.1308	0.1751	0.2418	0.4092
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.6614	0.9786	1.3315	2.1366	3.2154
Avg Wait Time: C	0.7399	0.9972	1.166	1.6314	2.5238
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	4.9138	7.2069	7.4222	14.6262	19.4748
Avg Total Time in System: A	3.6388	3.644	3.6523	3.6584	3.6729
Min Total Time in System: A	2.5398	2.4205	2.5433	2.5405	2.4962
Max Total Time in System: A	4.9268	4.8933	4.8691	4.7276	4.8727
Avg Total Time in System: B	3.6751	3.7062	3.7516	3.8185	3.983
Min Total Time in System: B	2.4967	2.6366	2.5472	2.6576	2.6385
Max Total Time in System: B	4.8404	4.9501	5.2076	5.8151	6.7946
Avg Total Time in System: C	4.3145	4.5755	4.743	5.2099	6.0995
Min Total Time in System: C	2.6726	2.7169	2.5949	2.7454	2.7636
Max Total Time in System: C	8.7745	10.841	11.123	18.5106	23.2705
Avg Number Waiting: Credit Check	2.6387	2.8818	2.7198	2.6989	2.5706
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	22	22	17	24	18
Avg Number Waiting: Order Picking	1.93	2.2492	2.175	2.065	2.0134
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	20	30	27	24	21
Avg Number Waiting: Order Processing	7.9317	8.6116	8.3763	8.6519	8.4463
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	61	75	71	79	68
Instantaneous Utilization: Credit Checkers	0.9422	0.9458	0.9475	0.9442	0.9396
Instantaneous Utilization: Order Picker	0.9464	0.9507	0.9527	0.9474	0.9452
Instantaneous Utilization: Order Processor	0.9432	0.9457	0.9475	0.9439	0.941

4. Simulation Data for Holding the Percentage of C Priority Orders Constant

A items %	1%	2%	3%	4%	5%	6%
A TBA	3.3333333	1.6666667	1.1111111	0.8333333	0.6666667	0.5555556
B items %	39%	38%	37%	36%	35%	34%
B TBA	0.085470085	0.087719298	0.09009009	0.092592593	0.095238095	0.098039216
C items	60%	60%	60%	60%	60%	60%
C TBA	0.055555556	0.055555556	0.055555556	0.055555556	0.055555556	0.055555556
20 Runs						
Number In	5679	5717	5681	5720	5687	5717
Number Out	5678	5710	5682	5711	5683	5710
Total Percent Out	99.98%	99.88%	100.02%	99.84%	99.93%	99.88%
Number In A	56	116	171	228	285	343
Number Out A	56	115	171	228	284	342
Percent Out A	100.00%	99.14%	100.00%	100.00%	99.65%	99.71%
Number In B	2202	2173	2115	2062	1980	1952
Number Out B	2201	2171	2118	2061	1978	1951
Percent Out B	99.95%	99.91%	100.14%	99.95%	99.90%	99.95%
Number In C	3421	3428	3395	3430	3422	3422
Number Out C	3421	3424	3393	3422	3421	3417
Percent Out C	100.00%	99.88%	99.94%	99.77%	99.97%	99.85%
Avg Wait Time: A	0.05230998	0.05498425	0.05367479	0.05553694	0.05391896	0.05634489
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2274	0.2242	0.2371	0.2761	0.2604	0.2706
Avg Wait Time: B	0.073905	0.07720835	0.07499457	0.07776967	0.07715361	0.08070441
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.4736	0.4415	0.5284	0.4264	0.5067	0.4879
Avg Wait Time: C	0.6301	0.7217	0.631	0.7003	0.628	0.727
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	4.6029	6.2573	3.4553	4.0247	3.9	4.6063
Avg Total Time in System: A	3.6289	3.6321	3.6265	3.633	3.6335	3.633
Min Total Time in System: A	2.6486	2.5592	2.7626	2.6642	2.4946	2.5505
Max Total Time in System: A	4.5589	4.6139	4.5329	4.66	4.8499	4.6205
Avg Total Time in System: B	3.6495	3.6519	3.6522	3.6541	3.6542	3.6571
Min Total Time in System: B	2.5611	2.538	2.5965	2.5321	2.467	2.5612
Max Total Time in System: B	4.899	4.7717	4.8217	4.8707	4.743	4.7137
Avg Total Time in System: C	4.2053	4.2982	4.2065	4.2761	4.2037	4.3034
Min Total Time in System: C	2.6168	2.6687	2.6229	2.4823	2.6237	2.6561
Max Total Time in System: C	8.4617	10.3959	7.2978	8.1285	7.8823	8.5685
Avg Number Waiting: Credit Check	2.7218	2.7385	2.6387	2.8345	2.6805	2.9464
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	23	15	17	22	16	19
Avg Number Waiting: Order Picking	1.983	2.4285	1.8949	2.3242	2.0499	2.5793
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	22	32	21	29	32	43
Avg Number Waiting: Order Processing	7.5412	8.9175	7.684	8.6052	7.5097	8.6778
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	82	89	54	63	55	73
Instantaneous Utilization: Credit Checkers	0.9423	0.9474	0.9419	0.9476	0.9433	0.9475
Instantaneous Utilization: Order Picker	0.9473	0.952	0.946	0.9513	0.9476	0.9523
Instantaneous Utilization: Order Processor	0.9418	0.9476	0.9419	0.9479	0.9425	0.9468

A items %	7%	8%	9%	10%	11%	12%
A TBA	0.4761905	0.4166667	0.3703704	0.3333333	0.3030303	0.2777778
B items %	33%	32%	31%	30%	29%	28%
B TBA	0.101010101	0.104166667	0.107526882	0.111111111	0.114942529	0.119047619
C items	60%	60%	60%	60%	60%	60%
C TBA	0.055555556	0.055555556	0.055555556	0.055555556	0.055555556	0.055555556
20 Runs						
Number In	5676	5700	5739	5690	5722	5699
Number Out	5674	5692	5738	5686	5714	5693
Total Percent Out	99.96%	99.86%	99.98%	99.93%	99.86%	99.89%
Number In A	404	459	518	563	630	685
Number Out A	403	458	519	564	630	685
Percent Out A	99.75%	99.78%	100.19%	100.18%	100.00%	100.00%
Number In B	1872	1821	1777	1708	1647	1605
Number Out B	1871	1821	1780	1711	1645	1604
Percent Out B	99.95%	100.00%	100.17%	100.18%	99.88%	99.94%
Number In C	3400	3420	3444	3419	3445	3409
Number Out C	3400	3413	3439	3411	3439	3404
Percent Out C	100.00%	99.80%	99.85%	99.77%	99.83%	99.85%
Avg Wait Time: A	0.05522866	0.05656597	0.05887111	0.05680309	0.05744535	0.05722652
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2562	0.2827	0.3011	0.2788	0.2487	0.3053
Avg Wait Time: B	0.07716665	0.07981693	0.08378098	0.07955203	0.08236513	0.08094542
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.4926	0.6432	0.5664	0.487	0.5577	0.4997
Avg Wait Time: C	0.5868	0.6532	0.7756	0.628	0.6534	0.6328
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	3.555	3.8334	3.9671	3.6229	4.9096	3.567
Avg Total Time in System: A	3.6355	3.6329	3.6379	3.6368	3.6327	3.6309
Min Total Time in System: A	2.6966	2.5985	2.544	2.5328	2.6266	2.6843
Max Total Time in System: A	4.6533	4.6711	4.7681	4.5707	4.6694	4.637
Avg Total Time in System: B	3.6516	3.657	3.6612	3.6552	3.6578	3.6571
Min Total Time in System: B	2.544	2.5576	2.5866	2.5751	2.5818	2.5
Max Total Time in System: B	4.7954	4.7386	4.7686	4.7004	4.8095	4.9612
Avg Total Time in System: C	4.1626	4.2287	4.3525	4.2028	4.2311	4.208
Min Total Time in System: C	2.5848	2.5623	2.6823	2.7264	2.714	2.4989
Max Total Time in System: C	7.4342	7.6936	7.7963	7.7027	8.5976	7.6861
Avg Number Waiting: Credit Check	2.4353	2.6523	2.9601	2.6148	2.7918	2.5846
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	19	18	22	20	20	15
Avg Number Waiting: Order Picking	1.7809	2.0186	2.6496	1.9965	2.0913	1.8527
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	18	19	33	20	23	20
Avg Number Waiting: Order Processing	7.2066	8.1768	9.4605	7.68	7.9354	7.8995
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	51	65	64	50	80	57
Instantaneous Utilization: Credit Checkers	0.9405	0.9439	0.9505	0.9431	0.9479	0.9444
Instantaneous Utilization: Order Picker	0.9455	0.949	0.9565	0.9481	0.9529	0.9481
Instantaneous Utilization: Order Processor	0.9405	0.9451	0.951	0.9436	0.9478	0.945

A items %	13%	14%	15%	16%	17%	18%
A TBA	0.2564103	0.2380952	0.2222222	0.2083333	0.1960784	0.1851852
B items %	27%	26%	25%	24%	23%	22%
B TBA	0.12345679	0.128205128	0.133333333	0.138888889	0.144927536	0.151515152
C items	60%	60%	60%	60%	60%	60%
C TBA	0.055555556	0.055555556	0.055555556	0.055555556	0.055555556	0.055555556
20 Runs						
Number In	5696	5687	5711	5700	5682	5711
Number Out	5689	5685	5699	5699	5685	5706
Total Percent Out	99.88%	99.96%	99.79%	99.98%	100.05%	99.91%
Number In A	748	797	858	910	966	1027
Number Out A	747	796	857	911	969	1028
Percent Out A	99.87%	99.87%	99.88%	100.11%	100.31%	100.10%
Number In B	1537	1483	1432	1367	1306	1251
Number Out B	1533	1480	1429	1367	1308	1252
Percent Out B	99.74%	99.80%	99.79%	100.00%	100.15%	100.08%
Number In C	3411	3407	3421	3423	3410	3433
Number Out C	3409	3409	3413	3421	3408	3426
Percent Out C	99.94%	100.06%	99.77%	99.94%	99.94%	99.80%
Avg Wait Time: A	0.05701314	0.05806241	0.06001951	0.05890262	0.0593798	0.06141811
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2843	0.2887	0.2849	0.3083	0.38	0.311
Avg Wait Time: B	0.08059903	0.08170804	0.0861065	0.08340315	0.0839137	0.08820217
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.5081	0.5373	0.5294	0.703	0.6405	0.6086
Avg Wait Time: C	0.5899	0.6272	0.6867	0.626	0.6221	0.7693
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	4.1691	4.0536	3.7438	3.459	3.5157	5.5542
Avg Total Time in System: A	3.6321	3.6323	3.6397	3.6355	3.6366	3.6364
Min Total Time in System: A	2.4528	2.7003	2.5329	2.5295	2.5979	2.6793
Max Total Time in System: A	4.7563	4.6909	4.6258	4.7134	4.9977	4.6103
Avg Total Time in System: B	3.6552	3.6552	3.6623	3.66	3.659	3.6643
Min Total Time in System: B	2.5664	2.5653	2.5702	2.4558	2.4221	2.5689
Max Total Time in System: B	4.983	4.8184	4.7351	4.7839	4.8051	4.623
Avg Total Time in System: C	4.1669	4.2036	4.2622	4.2012	4.1988	4.3457
Min Total Time in System: C	2.5716	2.6261	2.6752	2.5979	2.6025	2.6419
Max Total Time in System: C	8.4684	8.1384	7.7938	7.3757	7.28	9.3449
Avg Number Waiting: Credit Check	2.5637	2.5297	2.7189	2.7749	2.8852	2.9236
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	18	16	17	21	22	30
Avg Number Waiting: Order Picking	1.6598	2.1594	2.2059	1.8391	1.927	2.2433
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	18	31	26	19	21	25
Avg Number Waiting: Order Processing	7.3002	7.528	8.4935	7.5743	7.2923	9.8418
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	60	58	64	51	52	91
Instantaneous Utilization: Credit Checkers	0.9438	0.9425	0.9451	0.9454	0.9419	0.9463
Instantaneous Utilization: Order Picker	0.9476	0.947	0.9504	0.9493	0.9475	0.951
Instantaneous Utilization: Order Processor	0.9434	0.9429	0.9457	0.945	0.9422	0.9465

A items %	19%	20%
A TBA	0.1754386	0.1666667
B items %	21%	20%
B TBA	0.158730159	0.166666667
C items	60%	60%
C TBA	0.055555556	0.055555556
20 Runs		
Number In	5712	5670
Number Out	5709	5671
Total Percent Out	99.95%	100.02%
Number In A	1082	1139
Number Out A	1083	1138
Percent Out A	100.09%	99.91%
Number In B	1202	1127
Number Out B	1203	1129
Percent Out B	100.08%	100.18%
Number In C	3428	3404
Number Out C	3423	3404
Percent Out C	99.85%	100.00%
Avg Wait Time: A	0.0614656	0.05966258
Min Wait Time: A	0	0
Max Wait Time: A	0.3167	0.3096
Avg Wait Time: B	0.08708651	0.08530298
Min Wait Time: B	0	0
Max Wait Time: B	0.6577	0.6116
Avg Wait Time: C	0.6918	0.5538
Min Wait Time: C	0	0
Max Wait Time: C	3.8681	2.9647
Avg Total Time in System: A	3.6366	3.6328
Min Total Time in System: A	2.4511	2.412
Max Total Time in System: A	4.6846	4.782
Avg Total Time in System: B	3.6621	3.6623
Min Total Time in System: B	2.606	2.6004
Max Total Time in System: B	4.8252	4.7951
Avg Total Time in System: C	4.2679	4.1301
Min Total Time in System: C	2.6054	2.5727
Max Total Time in System: C	7.5624	6.672
Avg Number Waiting: Credit Check	2.7455	2.4971
Min Number Waiting: Credit Check	0	0
Max Number Waiting: Credit Check	19	24
Avg Number Waiting: Order Picking	2.1651	1.7516
Min Number Waiting: Order Picking	0	0
Max Number Waiting: Order Picking	26	24
Avg Number Waiting: Order Processing	8.5618	6.5258
Min Number Waiting: Order Processing	0	0
Max Number Waiting: Order Processing	53	42
Instantaneous Utilization: Credit Checkers	0.9465	0.9397
Instantaneous Utilization: Order Picker	0.9512	0.9446
Instantaneous Utilization: Order Processor	0.9475	0.9401

5. Simulation Data for the Variability Benchmark

A items %	Benchmark 5%	Benchmark 10%	Benchmark 15%	Benchmark 20%	Benchmark 25%
A TBA	33.33%	33.33%	33.33%	33.33%	33.33%
	0.1	0.1	0.1	0.1	0.1
B items %					
B TBA	33.33%	33.33%	33.33%	33.33%	33.33%
	0.1	0.1	0.1	0.1	0.1
C items					
C TBA	33.33%	33.33%	33.33%	33.33%	33.33%
	0.1	0.1	0.1	0.1	0.1
Variability of System	**5%**	**10%**	**15%**	**20%**	**25%**
Number In	5668	5700	5704	5716	5721
Number Out	5672	5691	5696	5712	5712
Total Percent Out	1.000705716	0.998421053	0.998597475	0.99930021	0.998426848
Number In A	1892	1908	1914	1903	1898
Number Out A	1894	1904	1908	1903	1894
Percent Out A	1.001057082	0.997903564	0.996865204	1	0.997892518
Number In B	1896	1901	1894	1914	1907
Number Out B	1897	1899	1895	1912	1904
Percent Out B	1.000527426	0.998947922	1.000527983	0.998955068	0.998426848
Number In C	1880	1891	1896	1899	1916
Number Out C	1881	1888	1893	1897	1914
Percent Out C	1.000531915	0.998413538	0.998417722	0.998946814	0.998956159
Avg Wait Time: A	0.3053	0.3775	0.4228	0.4959	0.5422
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	1.8397	2.2141	2.6806	2.4574	4.5504
Avg Wait Time: B	0.3088	0.3794	0.4221	0.5016	0.5438
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	1.6906	2.2687	2.623	2.4473	4.3697
Avg Wait Time: C	0.3046	0.376	0.4254	0.4983	0.5435
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	1.706	2.2278	2.611	2.504	4.4465
Avg Total Time in System: A	3.881	3.9536	3.9979	4.0707	4.1203
Min Total Time in System: A	3.2641	2.9297	2.5959	2.2469	1.9275
Max Total Time in System: A	5.458	5.9939	6.5303	6.5612	8.5194
Avg Total Time in System: B	3.8844	3.9549	3.9977	4.0778	4.1215
Min Total Time in System: B	3.292	2.9736	2.5761	2.3031	2.021
Max Total Time in System: B	5.3361	5.7981	6.5557	6.8086	8.6964
Avg Total Time in System: C	3.8805	3.9529	4.0018	4.0743	4.1191
Min Total Time in System: C	3.2486	2.9486	2.5434	2.2878	1.6828
Max Total Time in System: C	5.4225	5.9003	6.622	6.4699	8.6584
Avg Number Waiting: Credit Check	1.2344	2.0726	2.6089	3.6051	4.1004
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	10	14	20	22	26
Avg Number Waiting: Order Picking	1.0997	1.7273	2.1125	2.6142	3.1393
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	13	19	23	28	39
Avg Number Waiting: Order Processing	6.8138	7.6326	8.1902	8.8388	9.3298
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	50	59	82	64	118
Instantaneous Utilization: Credit Checkers	0.9405	0.9439	0.9439	0.9476	0.9476
Instantaneous Utilization: Order Picker	0.9454	0.9488	0.9492	0.9518	0.9519
Instantaneous Utilization: Order Processor	0.9403	0.9445	0.9453	0.9487	0.9468

A items %	Benchmark 30%	Benchmark 35%	Benchmark 40%	Benchmark 45%	Benchmark 50%
A TBA	33.33%	33.33%	33.33%	33.33%	33.33%
	0.1	0.1	0.1	0.1	0.1
B items %					
B TBA	33.33%	33.33%	33.33%	33.33%	33.33%
	0.1	0.1	0.1	0.1	0.1
C items					
C TBA	33.33%	33.33%	33.33%	33.33%	33.33%
	0.1	0.1	0.1	0.1	0.1
Variability of System	**30%**	**35%**	**40%**	**45%**	**50%**
Number In	5688	5704	5696	5680	5690
Number Out	5678	5694	5686	5677	5686
Total Percent Out	0.998241913	0.998246844	0.998244382	0.999471831	0.999297012
Number In A	1901	1893	1898	1888	1895
Number Out A	1897	1889	1895	1889	1895
Percent Out A	0.997895844	0.997886952	0.998419389	1.000529661	1
Number In B	1895	1906	1900	1902	1883
Number Out B	1890	1902	1898	1899	1882
Percent Out B	0.997361478	0.997901364	0.998947368	0.998422713	0.999468933
Number In C	1892	1905	1898	1890	1912
Number Out C	1891	1903	1893	1889	1909
Percent Out C	0.999471459	0.998950131	0.997365648	0.999470899	0.998430962
Avg Wait Time: A	0.5242	0.6238	0.6057	0.6448	0.8013
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	2.7331	3.3042	2.6443	3.1791	3.5404
Avg Wait Time: B	0.5246	0.6241	0.6004	0.644	0.7983
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	2.9129	3.3552	2.5768	3.2706	3.4253
Avg Wait Time: C	0.5261	0.6245	0.6014	0.6466	0.7972
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	2.7919	3.3785	2.7191	3.1961	3.4268
Avg Total Time in System: A	4.0965	4.1978	4.1828	4.2223	4.39
Min Total Time in System: A	1.6911	1.5475	0.8861	1.0133	0.5812
Max Total Time in System: A	7.7092	8.0637	7.8779	8.1644	9.6376
Avg Total Time in System: B	4.1033	4.2002	4.1828	4.2302	4.3932
Min Total Time in System: B	1.8136	1.2672	1.1012	0.9518	0.9868
Max Total Time in System: B	7.6014	8.2342	7.8244	8.7662	9.5404
Avg Total Time in System: C	4.1031	4.2046	4.177	4.2306	4.3875
Min Total Time in System: C	1.7921	1.5602	1.213	0.9793	0.7491
Max Total Time in System: C	7.4889	8.9628	7.8386	9.1229	9.4463
Avg Number Waiting: Credit Check	4.258	4.6332	5.3248	5.9284	6.7668
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	34	34	40	42	44
Avg Number Waiting: Order Picking	3.0477	4.4729	3.7486	4.3245	5.3697
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	29	56	60	52	47
Avg Number Waiting: Order Processing	8.5692	9.7645	9.1452	9.1496	11.965
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	68	81	59	82	96
Instantaneous Utilization: Credit Checkers	0.9421	0.9439	0.9446	0.9432	0.9456
Instantaneous Utilization: Order Picker	0.946	0.9492	0.9481	0.948	0.9521
Instantaneous Utilization: Order Processor	0.9428	0.947	0.9451	0.9433	0.9487

6. Simulation Data for Variability Runs

A items %	10%	10%	10%	10%	10%
A TBA	0.333333333	0.333333333	0.333333333	0.333333333	0.3333333
B items %	30%	30%	30%	30%	30%
B TBA	0.111111111	0.111111111	0.111111111	0.111111111	0.1111111
C items	60%	60%	60%	60%	60%
C TBA	0.055555556	0.055555556	0.055555556	0.055555556	0.0555556
Variability of System	**5%**	**10%**	**15%**	**20%**	**25%**
Number In	5683	5712	5690	5689	5709
Number Out	5692	5703	5686	5682	5703
Total Percent Out	100.16%	99.84%	100%	99.88%	99.89%
Number In A	562	568	563	572	577
Number Out A	562	567	564	572	578
Percent Out A	100.00%	99.82%	100.18%	100.00%	100.17%
Number In B	1703	1712	1708	1712	1715
Number Out B	1705	1711	1711	1713	1713
Percent Out B	100.12%	99.94%	100.18%	100.06%	99.88%
Number In C	3418	3432	3419	3405	3417
Number Out C	3425	3425	3411	3397	3412
Percent Out C	100.20%	99.80%	99.77%	99.77%	99.85%
Avg Wait Time: A	0.05235928	0.05487992	0.05680309	0.05752064	0.060316
Min Wait Time: A	0	0	0	0	0
Max Wait Time: A	0.259	0.2324	0.2788	0.2879	0.3006
Avg Wait Time: B	0.07013491	0.07751274	0.07955203	0.08136743	0.0861068
Min Wait Time: B	0	0	0	0	0
Max Wait Time: B	0.466	0.5204	0.487	0.5169	0.693
Avg Wait Time: C	0.5245	0.576	0.628	0.6527	0.8177
Min Wait Time: C	0	0	0	0	0
Max Wait Time: C	3.8475	3.7887	3.6229	4.3806	4.3975
Avg Total Time in System: A	3.6294	3.6303	3.6368	3.6367	3.6444
Min Total Time in System: A	3.285	2.8823	2.5328	2.2125	1.7143
Max Total Time in System: A	3.9673	4.432	4.5707	5.0163	5.2987
Avg Total Time in System: B	3.6466	3.6542	3.6552	3.6565	3.6619
Min Total Time in System: B	3.2834	2.7427	2.5751	2.0718	1.8263
Max Total Time in System: B	4.1443	4.4134	4.7004	5.0861	5.7972
Avg Total Time in System: C	4.1001	4.1522	4.2028	4.2285	4.3933
Min Total Time in System: C	3.234	2.9231	2.7264	2.1656	2.1306
Max Total Time in System: C	7.5003	7.6803	7.7027	8.3755	8.5971
Avg Number Waiting: Credit Check	1.2433	1.9391	2.6148	3.1776	3.8755
Min Number Waiting: Credit Check	0	0	0	0	0
Max Number Waiting: Credit Check	7	12	20	24	35
Avg Number Waiting: Order Picking	1.2494	1.6279	1.9965	2.122	2.8111
Min Number Waiting: Order Picking	0	0	0	0	0
Max Number Waiting: Order Picking	15	16	20	18	28
Avg Number Waiting: Order Processing	7.6676	7.853	7.68	7.4173	9.065
Min Number Waiting: Order Processing	0	0	0	0	0
Max Number Waiting: Order Processing	63	70	50	61	64
Instantaneous Utilization: Credit Checkers	0.9431	0.946	0.9431	0.9426	0.9454
Instantaneous Utilization: Order Picker	0.9485	0.9506	0.9481	0.9469	0.9504
Instantaneous Utilization: Order Processor	0.9429	0.9461	0.9436	0.9431	0.9466

A items %	15%	15%	15%	15%	15%	15%
A TBA	0.222222222	0.222222222	0.222222222	0.222222222	0.222222222	0.222222222
B items %	30%	30%	30%	30%	30%	30%
B TBA	0.111111111	0.111111111	0.111111111	0.111111111	0.111111111	0.111111111
C items	55%	55%	55%	55%	55%	55%
C TBA	0.060606061	0.060606061	0.060606061	0.060606061	0.060606061	0.060606061
Variability of System	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**
Number In	5699	5710	5690	5685	5718	5699
Number Out	5691	5706	5686	5691	5714	5698
Total Percent Out	99.86%	99.93%	100%	100.11%	99.93%	99.98%
Number In A	856	845	563	847	866	859
Number Out A	854	845	564	849	866	861
Percent Out A	99.77%	100.00%	100.18%	100.24%	100.00%	100.23%
Number In B	1709	1719	1708	1721	1712	1713
Number Out B	1706	1717	1711	1720	1711	1713
Percent Out B	99.82%	99.88%	100.18%	99.94%	99.94%	100.00%
Number In C	3134	3146	3419	3117	3140	3127
Number Out C	3131	3144	3411	3122	3137	3124
Percent Out C	99.90%	99.94%	99.77%	100.16%	99.90%	99.90%
Avg Wait Time: A	0.05436624	0.05740277	0.05680309	0.06026473	0.0633946	0.06362416
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2648	0.2773	0.2788	0.3147	0.3159	0.3074
Avg Wait Time: B	0.07768687	0.08509243	0.07955203	0.0925	0.0975	0.1007
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.5069	0.6411	0.487	0.7021	0.589	0.642
Avg Wait Time: C	0.555	0.6106	0.628	0.7786	0.888	0.9152
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	3.2944	3.6119	3.6229	4.4383	4.8631	4.2799
Avg Total Time in System: A	3.6317	3.6355	3.6368	3.6334	3.6365	3.6296
Min Total Time in System: A	3.2427	2.8969	2.5328	2.3278	1.8601	1.5616
Max Total Time in System: A	4.0028	4.3832	4.5707	5.1365	5.2952	5.7899
Avg Total Time in System: B	3.6543	3.6604	3.6552	3.6678	3.6724	3.6756
Min Total Time in System: B	3.2549	2.9397	2.5751	2.1683	1.9491	1.4803
Max Total Time in System: B	4.1941	4.4227	4.7004	5.2597	5.6514	6.037
Avg Total Time in System: C	4.13	4.1871	4.2028	4.3566	4.4659	4.49
Min Total Time in System: C	3.1799	2.9965	2.7264	2.2126	2.167	1.5267
Max Total Time in System: C	6.9093	7.441	7.7027	8.4368	9.4818	9.7195
Avg Number Waiting: Credit Check	1.2215	1.9978	2.6148	3.6038	4.2072	4.5797
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	8	12	20	25	33	34
Avg Number Waiting: Order Picking	1.2647	1.683	1.9965	2.4852	2.9219	3.0293
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	14	19	20	32	26	38
Avg Number Waiting: Order Processing	7.7023	7.4951	7.68	7.843	8.778	8.7436
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	53	59	50	51	74	68
Instantaneous Utilization: Credit Checkers	0.9437	0.9464	0.9431	0.9435	0.9486	0.9468
Instantaneous Utilization: Order Picker	0.9484	0.9511	0.9481	0.9486	0.9518	0.9489
Instantaneous Utilization: Order Processor	0.9443	0.9467	0.9436	0.9428	0.9474	0.9462

A items %	15%	15%	15%	15%
A TBA	0.222222222	0.222222222	0.222222222	0.222222222
B items %	30%	30%	30%	30%
B TBA	0.111111111	0.111111111	0.111111111	0.111111111
C items	55%	55%	55%	55%
C TBA	0.060606061	0.060606061	0.060606061	0.060606061
Variability of System	**35%**	**40%**	**45%**	**50%**
Number In	5687	5723	5730	5702
Number Out	5680	5720	5720	5688
Total Percent Out	99.88%	99.95%	99.83%	99.75%
Number In A	850	857	862	856
Number Out A	851	857	861	855
Percent Out A	100.12%	100.00%	99.88%	99.88%
Number In B	1712	1721	1715	1707
Number Out B	1714	1718	1712	1707
Percent Out B	100.12%	99.83%	99.83%	100.00%
Number In C	3125	3145	3153	3139
Number Out C	3115	3145	3147	3126
Percent Out C	99.68%	100.00%	99.81%	99.59%
Avg Wait Time: A	0.06440901	0.06704964	0.07065968	0.07101934
Min Wait Time: A	0	0	0	0
Max Wait Time: A	0.365	0.3938	0.3678	0.3712
Avg Wait Time: B	0.1026	0.1072	0.1129	0.1142
Min Wait Time: B	0	0	0	0
Max Wait Time: B	0.7604	0.6988	0.7137	0.7803
Avg Wait Time: C	1.065	1.1029	1.4381	1.2897
Min Wait Time: C	0	0	0	0
Max Wait Time: C	8.7205	4.9219	8.2274	6.0823
Avg Total Time in System: A	3.6367	3.6425	3.6534	3.6533
Min Total Time in System: A	1.1146	0.6479	0.8292	0.6936
Max Total Time in System: A	6.1341	6.4666	7.0302	7.2287
Avg Total Time in System: B	3.6776	3.6907	3.7043	3.7114
Min Total Time in System: B	1.2151	1.0084	0.7013	0.6349
Max Total Time in System: B	6.5187	6.4154	6.6875	7.1573
Avg Total Time in System: C	4.6432	4.6808	5.0202	4.883
Min Total Time in System: C	1.1968	0.7037	0.9653	0.5509
Max Total Time in System: C	13.2117	9.653	13.1465	11.1616
Avg Number Waiting: Credit Check	4.4999	5.951	7.3993	6.8407
Min Number Waiting: Credit Check	0	0	0	0
Max Number Waiting: Credit Check	30	33	57	45
Avg Number Waiting: Order Picking	4.0773	4.1041	6.5772	5.0691
Min Number Waiting: Order Picking	0	0	0	0
Max Number Waiting: Order Picking	65	36	94	52
Avg Number Waiting: Order Processing	10.3452	9.6054	11.5209	10.9895
Min Number Waiting: Order Processing	0	0	0	0
Max Number Waiting: Order Processing	115	63	104	66
Instantaneous Utilization: Credit Checkers	0.9425	0.95	0.9526	0.9451
Instantaneous Utilization: Order Picker	0.9479	0.9512	0.956	0.9517
Instantaneous Utilization: Order Processor	0.9438	0.9502	0.9525	0.9493

7. Simulation Data for the Utilization Level Benchmark

A items %	Benchmark 76%	Benchmark 80%	Benchmark 85%
A TBA	33.33%	33.33%	33.33%
	0.123684211	0.1175	0.110588235
B items %			
B TBA	33.33%	33.33%	33.33%
	0.123684211	0.1175	0.110588235
C items			
C TBA	33.33%	33.33%	33.33%
	0.123684211	0.1175	0.110588235
Utilization of System	**76%**	**80%**	**85%**
Number In	4605	4841	5162
Number Out	4602	4839	5161
Total Percent Out	0.999348534	0.999586862	0.999806277
Number In A	1531	1617	1721
Number Out A	1528	1619	1719
Percent Out A	100%	100%	100%
Number In B	1536	1600	1716
Number Out B	1535	1597	1716
Percent Out B	0.999348958	0.998125	1
Number In C	1538	1624	1725
Number Out C	1539	1623	1726
Percent Out C	1.000650195	0.999384236	1.00057971
Avg Wait Time: A	0.07797917	0.1031	0.1457
Min Wait Time: A	0	0	0
Max Wait Time: A	0.6194	1.0231	1.0436
Avg Wait Time: B	0.07681294	0.1022	0.1485
Min Wait Time: B	0	0	0
Max Wait Time: B	0.6316	0.9532	1.0931
Avg Wait Time: C	0.07656991	0.1025	0.1461
Min Wait Time: C	0	0	0
Max Wait Time: C	0.6839	0.9173	1.0029
Avg Total Time in System: A	3.654	3.6802	3.7227
Min Total Time in System: A	2.5076	2.4772	2.5964
Max Total Time in System: A	4.7778	4.9482	5.3481
Avg Total Time in System: B	3.6514	3.6766	3.7232
Min Total Time in System: B	2.5926	2.5421	2.5782
Max Total Time in System: B	5.2152	5.0565	5.3012
Avg Total Time in System: C	3.6545	3.6774	3.7221
Min Total Time in System: C	2.5722	2.5579	2.5919
Max Total Time in System: C	4.7563	5.0242	5.3467
Avg Number Waiting: Credit Check	0.711	0.9046	1.2357
Min Number Waiting: Credit Check	0	0	0
Max Number Waiting: Credit Check	9	9	12
Avg Number Waiting: Order Picking	0.08690069	0.1846	0.3924
Min Number Waiting: Order Picking	0	0	0
Max Number Waiting: Order Picking	9	10	12
Avg Number Waiting: Order Processing	1.0806	1.536	2.3806
Min Number Waiting: Order Processing	0	0	0
Max Number Waiting: Order Processing	16	25	26
Instantaneous Utilization: Credit Checkers	0.7635	0.8025	0.8556
Instantaneous Utilization: Order Picker	0.7677	0.8068	0.8601
Instantaneous Utilization: Order Processor	0.7629	0.8031	0.8557

A items %	Benchmark 90%	Benchmark 94%	Benchmark 99%
A TBA	33.33%	33.33%	33.33%
	0.104444445	0.1	0.094949495
B items %			
B TBA	33.33%	33.33%	33.33%
	0.104444445	0.1	0.094949495
C items			
C TBA	33.33%	33.33%	33.33%
	0.104444445	0.1	0.094949495
Utilization of System	**90%**	**94%**	**99%**
Number In	5449	5704	6029
Number Out	5450	5696	5942
Total Percent Out	1.00018352	0.998597475	0.985569746
Number In A	1827	1914	2007
Number Out A	1827	1908	1978
Percent Out A	100%	100%	99%
Number In B	1809	1894	2036
Number Out B	1810	1895	2006
Percent Out B	1.000552792	1.000527983	0.985265226
Number In C	1813	1896	1986
Number Out C	1813	1893	1958
Percent Out C	1	0.998417722	0.985901309
Avg Wait Time: A	0.2463	0.4228	1.7266
Min Wait Time: A	0	0	0
Max Wait Time: A	1.7019	2.6806	5.7331
Avg Wait Time: B	0.2473	0.4221	1.7308
Min Wait Time: B	0	0	0
Max Wait Time: B	1.6532	2.623	5.7632
Avg Wait Time: C	0.247	0.4254	1.723
Min Wait Time: C	0	0	0
Max Wait Time: C	1.6945	2.611	5.764
Avg Total Time in System: A	3.8215	3.9979	5.3035
Min Total Time in System: A	2.5162	2.5959	2.7447
Max Total Time in System: A	5.8397	6.5303	9.7816
Avg Total Time in System: B	3.8233	3.9977	5.3086
Min Total Time in System: B	2.5097	2.5761	3.6527
Max Total Time in System: B	5.7735	6.5557	9.7883
Avg Total Time in System: C	3.8236	4.0018	5.298
Min Total Time in System: C	2.5763	2.5434	2.7955
Max Total Time in System: C	5.7668	6.622	10.0305
Avg Number Waiting: Credit Check	1.76	2.6089	8.1741
Min Number Waiting: Credit Check	0	0	0
Max Number Waiting: Credit Check	14	20	47
Avg Number Waiting: Order Picking	0.9701	2.1125	9.3078
Min Number Waiting: Order Picking	0	0	0
Max Number Waiting: Order Picking	17	23	68
Avg Number Waiting: Order Processing	4.3097	8.1902	38.7739
Min Number Waiting: Order Processing	0	0	0
Max Number Waiting: Order Processing	50	82	157
Instantaneous Utilization: Credit Checkers	0.9036	0.9439	0.9891
Instantaneous Utilization: Order Picker	0.9088	0.9492	0.9911
Instantaneous Utilization: Order Processor	0.9032	0.9453	0.9906

8. Simulation Data for Utilization Level Runs

A items %	10%	10%	10%	10%	10%	10%
A TBA	0.4177109	0.3916960	0.3685956	0.3481894	0.3333333	0.3133813
B items %	30%	30%	30%	30%	30%	30%
B TBA	0.1392369	0.1305653	0.122865	0.1160631	0.1111111	0.1044604
C items	60%	60%	60%	60%	60%	60%
C TBA	0.0696184	0.0652826	0.0614326	0.0580315	0.0555555	0.0522302
Utilization of System	**76%**	**80%**	**85%**	**90%**	**94%**	**99%**
Number In	4557	4821	5690	5473	5690	6040
Number Out	4561	4821	5686	5468	5686	5961
Total Percent Out	100.09%	100.00%	100%	99.91%	100%	98.69%
Number In A	455	483	513	544	563	607
Number Out A	457	482	511	545	564	607
Percent Out A	100.44%	99.79%	100.18%	100.18%	100.18%	100.00%
Number In B	1380	1455	1532	1654	1708	1819
Number Out B	1381	1455	1534	1651	1711	1814
Percent Out B	100.07%	100.00%	100.13%	99.82%	100.18%	99.73%
Number In C	2722	2883	3097	3275	3419	3614
Number Out C	2723	2884	3098	3272	3411	3540
Percent Out C	100.04%	100.03%	99.77%	99.91%	99.77%	97.95%
Avg Wait Time: A	0.02775424	0.032638	0.03918972	0.04720874	0.05680309	0.07384871
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2411	0.2061	0.2395	0.2728	0.2788	0.3112
Avg Wait Time: B	0.03603943	0.04284003	0.05197738	0.06572411	0.07955203	0.1132
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.3161	0.3872	0.4556	0.4735	0.487	0.6589
Avg Wait Time: C	0.1022	0.1411	0.2151	0.3491	0.628	2.8595
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	1.0873	1.4584	1.7573	2.1965	3.6229	11.5647
Avg Total Time in System: A	3.604	3.608	3.6169	3.6182	3.6368	3.6452
Min Total Time in System: A	2.4984	2.4909	2.4868	2.629	2.5328	2.6905
Max Total Time in System: A	4.6297	4.5639	4.6406	4.8157	4.5707	4.597
Avg Total Time in System: B	3.6141	3.6177	3.6285	3.6474	3.6552	3.6913
Min Total Time in System: B	2.5315	2.5138	2.5689	2.6368	2.5751	2.5354
Max Total Time in System: B	4.8443	4.6607	4.6911	4.8186	4.7004	4.8493
Avg Total Time in System: C	3.6776	3.7187	3.7902	3.9246	4.2028	6.4364
Min Total Time in System: C	2.5021	2.4732	2.442	2.4596	2.7264	2.6418
Max Total Time in System: C	5.0511	5.2951	5.6148	6.1921	7.7027	15.396
Avg Number Waiting: Credit Check	0.6795	0.8798	1.2349	1.7789	2.6148	6.6917
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	8	10	13	12	20	28
Avg Number Waiting: Order Picking	0.07774259	0.1765	0.4415	0.8923	1.9965	11.7604
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	10	10	13	13	20	63
Avg Number Waiting: Order Processing	1.0332	1.499	2.3525	4.0811	7.68	38.6731
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	16	21	28	36	50	162
Instantaneous Utilization: Credit Checkers	0.7555	0.7994	0.8519	0.9073	0.9431	0.9917
Instantaneous Utilization: Order Picker	0.7595	0.8048	0.8571	0.9115	0.9481	0.994
Instantaneous Utilization: Order Processor	0.7555	0.7989	0.8523	0.907	0.9436	0.9929

A items %	15%	15%	15%	15%	15%	15%
A TBA	0.2784740	0.26113	0.24573	0.23213	0.22222	0.20892
B items %	30%	30%	30%	30%	30%	30%
B TBA	0.1392370	0.1305653	0.1228652	0.1160631	0.1111111	0.1044605
C items	55%	55%	55%	55%	55%	55%
C TBA	0.0759474	0.0712175	0.0670174	0.0633072	0.0606061	0.0569784
Utilization of System	**76%**	**80%**	**85%**	**90%**	**94%**	**99%**
Number In	4547	4839	5690	5466	5694	6050
Number Out	4548	4838	5686	5461	5692	5964
Total Percent Out	100.02%	99.98%	100%	99.91%	99.96%	98.58%
Number In A	686	721	777	822	853	904
Number Out A	686	721	777	823	854	904
Percent Out A	100.00%	100.00%	100.18%	100.12%	100.12%	100.00%
Number In B	1367	1452	1552	1651	1708	1816
Number Out B	1366	1453	1552	1648	1709	1816
Percent Out B	99.93%	100.07%	100.00%	99.82%	100.06%	100.00%
Number In C	2494	2666	2820	2993	3133	3330
Number Out C	2496	2664	2819	2990	3129	3244
Percent Out C	100.08%	99.92%	99.77%	99.90%	99.87%	97.42%
Avg Wait Time: A	0.02842249	0.03385728	0.03976589	0.04996846	0.05984599	0.07684589
Min Wait Time: A	0	0	0	0	0	0
Max Wait Time: A	0.2336	0.2193	0.2505	0.3051	0.3071	0.3364
Avg Wait Time: B	0.03831099	0.04627638	0.05648166	0.07276226	0.0909	0.1244
Min Wait Time: B	0	0	0	0	0	0
Max Wait Time: B	0.4062	0.4018	0.4645	0.5732	0.6587	0.7412
Avg Wait Time: C	0.1055	0.1497	0.2203	0.3949	0.8305	3.2242
Min Wait Time: C	0	0	0	0	0	0
Max Wait Time: C	1.3276	1.3876	1.8846	2.4384	5.4238	13.277
Avg Total Time in System: A	3.602	3.6099	3.6185	3.6244	3.6343	3.656
Min Total Time in System: A	2.3523	2.6391	2.6133	2.6288	2.506	2.646
Max Total Time in System: A	4.6491	4.6164	4.6918	4.9603	4.7522	4.6612
Avg Total Time in System: B	3.6152	3.624	3.6319	3.6497	3.6663	3.7005
Min Total Time in System: B	2.4675	2.4136	2.4908	2.5765	2.5296	2.5173
Max Total Time in System: B	4.6653	4.8916	4.7804	4.7821	4.9967	4.9776
Avg Total Time in System: C	3.6814	3.7254	3.7966	3.971	4.4072	6.7983
Min Total Time in System: C	2.5726	2.5582	2.5671	2.4511	2.5421	2.666
Max Total Time in System: C	5.4267	5.5968	5.7305	6.5458	9.2485	17.1523
Avg Number Waiting: Credit Check	0.6723	0.8969	1.1761	1.8602	2.9389	8.0575
Min Number Waiting: Credit Check	0	0	0	0	0	0
Max Number Waiting: Credit Check	9	9	10	14	21	51
Avg Number Waiting: Order Picking	0.07318142	0.1773	0.4206	1.0253	2.758	8.8621
Min Number Waiting: Order Picking	0	0	0	0	0	0
Max Number Waiting: Order Picking	11	11	15	21	39	45
Avg Number Waiting: Order Processing	1.0138	1.4964	2.2786	4.2259	9.2437	42.7068
Min Number Waiting: Order Processing	0	0	0	0	0	0
Max Number Waiting: Order Processing	16	21	29	40	67	183
Instantaneous Utilization: Credit Checkers	0.7541	0.8024	0.8531	0.9061	0.9442	0.9922
Instantaneous Utilization: Order Picker	0.7578	0.8068	0.8574	0.9106	0.9488	0.9936
Instantaneous Utilization: Order Processor	0.7539	0.8021	0.8529	0.9057	0.9435	0.9936